DIGNAN PHOTOGRAPHIC COLOR VOL NO. 1

HOW TO COMPOUND . . .

SIMPLIFIED COLOR PROCESSING FORMULAS

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PREFACE

There have been many important changes in the manufacture of color emulsions during the last few years.

Besides increased speed, finer grain and purer color rendering, the gelatin has been modified, so that most of the newer emulsions supplied today are "prehardened", thus allowing higher processing temperatures to be used.

These newer type "prehardened" emulsions have eliminated the need for a number of solutions and chemicals; gone are the prehardener and neutralizer solutions needed with E-4 Ektachromes. Chemicals such as sodium sulfate, potassium alum, etc., are no longer needed.

You will, therefore, find that with about 35 basic chemicals you can compound solutions to process all of the newer type emulsions.

WHERE TO PURCHASE CHEMICALS

All large photographic stores can supply most of the common basic chemicals that are used to compound black & white solutions, most of which are also used to compound color solutions. However, photo stores usually do not supply the more exotic "color developing agents", color accelerators, etc.

The following mail order companies supply all of the necessary chemicals in small amounts. Write for their catalogs:

Lauder Chemical Co. 350 Peninsula Ave. San Mateo, Ca. 94401	Porter's Camera Store P.O. Box 628 Cedar Falls, Ia. 50613	Zone V 291 Buckminster Rd. Brookline, Ma. 02146

The main object of this book is to present simplified formulas that can be used to replace the various chemical kits on the market. The only way to benefit from the information is to compound a set of solutions and compare the results against using the standard kits.

We think you will be pleasantly surprised.

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SIMPLIFIED COLOR PROCESSING FORMULAS

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UNDERSTANDING COLOR EMULSIONS.....THERE IS NO MAGIC.

All color emulsions produced throughout the world today, function by utilizing the following facts:

1. White light can be divided into three sections - BLUE, GREEN AND RED. These are called the Additive Primaries.
2. All color emulsions record the exposure in at least three different layers. One layer records the blue, one the green and one the red.
3. All photographic color emulsions rely on the light sensitive silver halides, bromide, iodide and chloride to form the image. Combinations of the silver halides are incorporated in the three separate layers using gelatin as the carrier.
4. The color dye formed in each layer is accomplished by using special colorless chemicals called "dye couplers". Different couplers are incorporated in each layer.
5. The dye formed in each layer is the result of the exposed silver, being processed in a solution containing a special "color developing agent". The development of the silver halide produces byproducts, which combine with the dye couplers to form dye.
6. The three dyes produced are always Subtractive Primaries. In the blue sensitive layer, yellow dye is formed, in the green sensitive layer, magenta dye is formed and in the red sensitive layer, cyan dye is formed.
7. After the dye has been formed, all of the silver (developed metallic silver plus the silver halide that was not developed) must be removed, leaving only the dye image. The silver is removed using a silver bleach and then a fixer, or these two operations are combined to form a bleach/fix or Blix.
8. Kodachrome is produced using all of the above rules, except the dye couplers are not incorporated in the different emulsion layers during manufacture, but are included in three different complex developing solutions.
9. Cibachrome (paper or transparency) also has three different silver halide sensitive layers. Sensitized blue, green and red. However, special subtractive yellow, magenta and cyan dyes are incorporated in the emulsion. It is important to note these are not couplers. The image is produced by a system known as "dye destruct".

If the aforementioned facts are thoroughly understood, you will have a clearer idea of just what is happening when you process a color emulsion, whether it be negative or positive, or whether it is a color print from a negative or a print made from a slide (positive to positive). Two articles in this book should be studied if the above facts are still vague; "When Magenta...Add Magenta" and "How to Win at Color Printing".

Before attempting to change the color balance of any color emulsion with processing changes, it is helpful to know the emulsion layer arrangement. (Suggested E-6 chemical changes are given on page 57)

HOW TO DETERMINE COLOR EMULSION LAYERS

1. All normal camera speed color films are coated with cyan next to the base, magenta in the middle and yellow on top. The new Kodak film, Kodacolor 400, departs from this arrangement by inter-mixing two layers of cyan and magenta.
2. If you view a wet processed film, negative or reversal transparency, you can readily see that the yellow is on top. The cyan can be viewed through the base.
3. Color print paper, can have the three dye layers in reverse order, which increases the sharpness of a print. For example, Kodak RC 37/74 has the cyan layer on top, magenta in the middle and yellow on the bottom, next to the base. The layer order in any color print material can easily be determined by carefully scratching a processed wet print in a black area. With RC 74, if you remove the cyan layer, you will see red (magenta + yellow). A deeper scratch will remove the magenta layer revealing yellow.

COLOR IS DIFFICULT NOT TO PRODUCE

The reaction between the silver halide and dye couplers in a color emulsion and the color developing agent in the solution is complex. If each solution is mixed correctly and used for the correct amount of time at the correct temperature, it is impossible not to produce a color image. Producing the correct color is the object of most photographic color systems.

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THE CHEMICALS USED IN COMPOUNDING COLOR SOLUTIONS

ACETIC ACID (Glacial) CH_3COOH — MW 60.05

Glacial Acetic Acid is pure 99% Acetic Acid. It is called Glacial because it freezes into glacial-like crystals at 62^oF. Vinegar is a dilute of Acetic Acid.

PROPERTIES: Clear, colorless, very pungent odor.

CAUTION: Glacial Acetic Acid causes severe burns.

SOLUBILITIES: Soluble in all proportions with water and alcohol.

PHOTOGRAPHIC USES: In photography a 2 to 3% solution is used as a stop bath. It is used as a general acid to lower the pH of fixing solutions. It is also used in some toners and intensifier formulas.

All formulas using Acetic Acid must stipulate the strength of the acid to use. To make 28% (approx.) Acetic Acid with glacial, dilute three parts glacial to eight parts of water.

Note that a stronger Acetic Acid stop bath is recommended for films and plates (also papers for graphic arts).

Vinegar is a weak solution of Acetic Acid. Because of the possibility of unknown impurities it should not be used for photographic processing.

USED IN FIXERS: Acetic Acid is used in many official and unofficial stop-fixers (see Thiosulfate). Two rules to remember are never add Acetic Acid to a fixer full strength. Dilute with water and also make certain the Sodium Sulfite is dissolved in the fixing solution first. If these rules are not adhered to, the hypo (Thiosulfate) will sulfurize. (Also see Sodium Diacetate and Thiosulfate).

BENZOTRIAZOLE $C_6H_5N_3$ — MW 119.12

PROPERTIES: White to tan color; odorless crystalline compound. Very stable toward acids and alkalies, and toward oxidation and reduction.

SOLUBILITIES: Sparingly soluble in water. Soluble in alcohol, benzene, toluene, chloroform.

TOXICITY: Limited animal experimentation suggests moderate toxicity.

PHOTOGRAPHIC USES: Also sold as Kodak Anti-Fog #1. It is used as a fog restrainer in emulsions and in photographic developers.

Although 6-Nitrobenzimidazole Nitrate can be substituted in some formulas (1 to 1), it should not be used as a substitute in highly alkaline developers. It will precipitate out of solution.

NOTE: Benzotriazole is difficult to dissolve. The best procedure is to make a percentage stock solution using hot (125^oF) distilled or deionized water. One gram of Benzotriazole to one liter of water is equal to .001 gram per ml. The stock solution should keep at least six months.

BENZYL ALCOHOL (Liquid) $C_6H_5CH_2OH$ MW 108.13

PROPERTIES: Liquid. Faint aromatic odor. Sharp burning taste. One gram dissolves in about 25. ml of water. One volume dissolves in 1.5 vols. of 50% Ethyl Alcohol.

SOLUBILITIES: Soluble in Ethylene Glycol, Diethylene Glycol and Propylene Glycol.

PHOTOGRAPHIC USES: Benzyl Alcohol is used in a number of color developers by Eastman Kodak. It acts as a color developing booster by serving as a penetrating agent into the otherwise waterproof dye-forming particles. It is also used in Ansco's color developer for their Ansco Color Print Paper. (Although GAF has stopped manufacturing color film emulsions, there is still a large amount of this material available which can be processed by the user). Manufacture of this paper is based on the Public Domain patents of Kodak. Increasing the amount of Benzyl Alcohol will result in an increase in speed, contrast and fog level. Not adding enough will produce symptons of underdevelopment. The effect will be different for each of the three emulsion layers.

The main problem you will have with this chemical is that it dissolves very slowly in water. Because Benzyl Alcohol is water-white it is difficult to see whether it has dissolved or not. When it is placed in water, you will notice oily particles floating on top. You must stir this solution until these particles ALL go into solution, which will take from 7 to 15 minutes. One way around this problem is the pre-mixing of a 40% solution of Benzyl Alcohol with water and Diethylene Glycol. Diethylene Glycol is soluble in water and in Benzyl Alcohol and serves as a mutual solvent. The following formula will keep indefinitely as a stock solution:

BENZYL ALCOHOL STOCK SOLUTION 40%

Benzyl Alcohol	40.0 ml
Diethylene Glycol	40.0 ml
Water to make	100.0 ml

3 ml of stock solution = 1.2 ml of Benzyl Alcohol.

BETA-PHENYLETHYLAMINE (Liquid) $C_8H_{11}N$ MW 121.18

PROPERTIES: Liquid with fishy odor; absorbs carbon dioxide from the air. Keep tightly closed. Strong base.

SOLUBILITIES: Freely soluble in water or alcohol.

PHOTOGRAPHIC USES: Unofficially used in Ansco formulas as a developer accelerator.

NOTE ON MIXING: Regardless of what method you use to mix an Ansco Color Developer, TAR will form from incorporating the Phenylethylamine. It matters not whether you purchase the kits or mix it from the basic chemicals. We can offer only two suggestions at this time.

BETA-PHENYLETHYLAMINE (Liquid) -Continued-

Use glass containers and a glass stirring rod, do not use plastic, the tar sticks to plastic and in many cases will dissolve the plastic. Using glass will not eliminate the problem of tar formation, but it will help in cleaning up after the solution is mixed. The last operation consists of filtering the solution before use or storage. This is important. Because the small globules of tar will raise havoc with the emulsion, leading to spots.

BETA-PHENYLETHYLAMINE HYDROCHLORIDE (Powder) $C_6H_5C_2H_4NH_2$ HCl

PHOTOGRAPHIC USES: Same as Beta-Phenylethylamine (liquid). OFFICIALLY used in Ansco Color Developing Formulas. There is also a sulfate salt of this same chemical.

GAF (Ansco) used the code name DA-3 for this chemical.

CONVERSION: 2.5 grams (3. ml) liquid is equal to 3.5 grams of the Hydrochloride.

BORAX (Pentahydrated) ($5H_2O$) $NA_2B_4O_7$ $5H_2O$

If the formula calls for Borax $10H_2O$ and you have Borax $5H_2O$, multiply by 0.76.

BORAX (Decahydrated) ($10H_2O$) $Na_2B_4O_7 10H_2O$ MW 381.43

PROPERTIES: Crystals, colorless, hard, odorless, or as granules or crystals. Also available as powder. A solution of Borax has a pH of about 9.5.

SOLUBILITIES: The Borax $10H_2O$ is 3% soluble in cold water--- 98% in hot water.

PHOTOGRAPHIC USES: As a mild alkali used in fine grain developers, also as an alkali buffer. It slowly dissociates, thereby maintaining the pH at a constant value. You will find Borax used in combination with Sodium Hydroxide in many formulas.

In color processing, Borax has been used to stabilize one or more of the dyes formed. Sun faded prints or slides can sometimes be restored by bathing in a 2% solution of Borax.

BORIC ACID H_3BO_3 MW 61.84

PROPERTIES: Colorless, odorless, transparent crystals or granular or powder. When making up photographic solutions, always use the crystal or granular form. The powder is very difficult to dissolve.

BORIC ACID -Continued-

SOLUBILITIES: Soluble in water, alcohol or glycerin. One gram dissolves in 18 ml of cold water, 4 ml of boiling water.

TOXICITY: 5. grams has caused death in infants. 5. to 20. grams has caused death in adults.

PHOTOGRAPHIC USES: It is used as a buffer in some developers. It is also used in fixing baths and bleach formulas.

Boric Acids buffering ability is the opposite of Borax, that is, it buffers on the acid side (pH under 7).

POTASSIUM BROMIDE KBr MW 119.01

PROPERTIES: Colorless crystals or powder.

SOLUBILITY: One gram dissolves in 1.5 ml of water or 1.0 ml of boiling water. Solutions have a neutral pH.

SODIUM BROMIDE NaBr MW 102.91

PROPERTIES: White crystal or powder. Absorbs moisture from the air. KEEP TIGHTLY CLOSED.

SOLUBILITIES: 1. gram in 1.1 ml of water--or 16. ml of alcohol. pH solution 6.5 to 8.0

PHOTOGRAPHIC USES: The main use for the Bromides are as restrainers in developers. They help prevent development of the silver halide that was NOT exposed. When this type of development does take place, the result is known as "fog". Bromide also retards development.

Bromide is also used in Ferricyanide bleaches to convert the metallic silver to silver bromide (see Ferricyanide).

SUBSTITUTIONS: If formulas call for Potassium Bromide and you have Sodium Bromide, multiply by 0.86. If formula calls for Sodium Bromide and you have Potassium Bromide, multiply by 1.16.

CALGON (Sodium Hexametaphosphate) $(NaPO_3)_6$

PROPERTIES: Supplied as a powder, flake or glass-like beads. The photo-grade is called unadjusted. We do not recommend the washing type of Calgon. Potassium Ash has been added to bring the pH to 8.6

PHOTOGRAPHIC USES: Sodium Hexametaphosphate is a water softener. It prevents calcium, carbonate, magnesium and iron salts from crystallizing out of processing solution.

The amount called for in most formulas is from 0.5 gram to 2.0 grams. If you use deionized water, Calgon need not be included in the formula. The use of distilled water may lead to copper contamination. Due to the fact that copper is used in most distillation systems, we therefore recommend deionized water when compounding developers. The use of the E.D.T.A.'s to sequester copper has some disadvantages. Hydroxylamine and E.D.T.A. reacts in the presence of copper to form nitrogen.

CITRAZINIC ACID $C_6S_5NO_4$ MW 155.11

PROPERTIES: Citrazinic Acid is a yellowish powder with a greenish tinge.

SOLUBILITIES: It is almost insoluble in water. It is soluble in Alkali Hydroxide or Carbonate solutions. Alkaline solutions turn blue on standing.

PHOTOGRAPHIC USES: Citrazinic Acid is used in a number of Kodak color developing solutions because it will react with some of the oxidation products of the color developing agents to form colorless compounds. Thus, it is possible to control the relationship between the amount of silver and the amount of dye formed in the image. This chemical gives us control over the contrast of the color image. It serves to prevent what would otherwise be an excessively dense and contrasty dye image. When used in Ektachrome processing, a deficiency results in a dense and over-magenta final balance. An excess amount will produce a thin and greenish balance.

PROCESSING EKTACHROME AS A NEGATIVE: Citrazinic Acid has been used to process high-speed Ektachrome to a negative in C-22 chemistry.

EXPOSURE: Shoot E.I. 160 to 640, depending upon brightness. For average subjects: E.I. 320.

TO MODIFY C-22 DEVELOPER

3.0 grams Citrazinic Acid
1.6 grams Sodium Hydroxide (to restore pH)

Add the above to quart kit of C-22 Developer and use as a one-shot.

DEVELOPING TIME: 12 minutes normal TEMP: 75°F

This system produces a negative without an orange mask.

CITRIC ACID (Mono-hydrate) $C_6H_8O_7H_2O$ MW 210.14

PROPERTIES: Colorless crystals, or white granular powder. Odorless, strong acid taste.

SOLUBILITIES: Citric Acid is very soluble in water, alcohol.

PHOTOGRAPHIC USES: Sometimes used to adjust pH of various formulas. It is also used as a sequestering agent to remove trace metals. However, it is only effective in the pH range from 2 to 9 for iron and copper. It is non-toxic. It is incompatible with Carbonates, Bicarbonate (forms CO_2), Acetate or Sulfides.

ETHYLENEDIAMINE $C_2H_8N_2$

PROPERTIES: Colorless, alkaline liquid, Ammonia odor. Strong base. Soluble in water or alcohol. WARNING: Hazardous liquid. Vapor may cause skin irritation. POISON!

PHOTOGRAPHIC USES: This is used as a substitution for part of the alkali in some Official Kodak Color Developers. The developing time of Kodachrome type solutions is considerably decreased and the bottom emulsion layer readily develops. Besides increasing the rate of penetration, an additional benefit is retarding deposition of a general dye fog.

ETHYLENEDIAMINE SULFATE (anhydrous) $NH_2C_2H_4NH_2H_2SO_4$

PROPERTIES: White stable powder.

Kodak in their Official E-4 Formulas makes the following statement: "Ethylenediamine Sulfate Anhydrous can be used instead of Ethylenediamine 100% base. To do this, multiply the formula quantity of Ethylenediamine 100% base by 2.62 and round off the results to the nearest 0.1 gram". The amount of Sodium Hydroxide must be changed to adjust pH.

THE E.D.T.A.'s or ETHYLENE DIAMINE TETRA ACETIC ACID and its salts

Although there are hundreds of trade names used, there are ONLY FIVE E.D.T.A.'s used in most photographic formulas.

E.D.T.A. ACID: This is the basic chemical. It is a colorless crystalline solid that is nonhygroscopic. It is stable on prolonged storage. It is insoluble in hot or cold water, alcohol, acetone or ether. Though considered insoluble in water, E.D.T.A. dissolves to the extend of 0.02% in distilled water. When electrolytes are present, solubility is increased. Even at 0.02%, however, they do perform. They are used wherever problems are encountered due to the presence of iron, copper, calcium and magnesium. They sequester hard water compounds of calcium and magnesium derivatives, more rapidly and completely on the alkaline side than on the acid side.

On the acid side, they are more rapid and effective in sequestering iron and copper. The iron and copper is sequestered on the alkaline side when sufficient time is allowed for the reaction to go to completion.

The stability of the E.D.T.A.'s in solutions make them especially valuable as chelating agents in photographic developing solutions and as a solubilizing agent to prevent turbidity in processing tanks and to prevent decomposition of hard water soaps on film and plates.

The E.D.T.A.'s have no wetting, detergent or penetrating action. E.D.T.A. forms complexes with cations of many metals including silver.

The E.D.T.A.'s used in photography are all white powders, except the Ferric Salt which is yellow-brown powder.

The Ferric Salt of E.D.T.A. is used in modern color photographic paper bleaches and bleach/fixers. It is used in many different color print bleaches.

POTASSIUM FERRICYANIDE $K_3Fe(CN)_6$ MW 329.18

PROPERTIES: Ruby-red crystals.

SOLUBILITIES: Freely soluble in water. Slightly soluble in alcohol. 2.5 parts cold water, 1.3 parts boiling water. Decomposed by acids. In solution, the Ferricyanide slowly decomposes on standing. PROTECT FROM LIGHT! The dry powders are very stable.

The main use of Ferricyanide, until recently, has been bleach formulas used for COLOR FILM, NEGATIVE, POSITIVE AND REVERSAL.

The current stress on ecology has resulted in attempting to find a substitute for Ferricyanide. E.D.T.A., Ferric Salt in combination with Thiosulfate can be used as a bleach/fix, however it is slower than Ferricyanide.

There are a number of things to remember about Ferricyanide. Just because this chemical has cyanide in it's name, it does not evolve cyanic acid during normal use. Cyanide is a very poisonous gas.

Potassium (or Sodium) Ferricyanide is not the same as Potassium (or Sodium) Ferrocyanide. Solutions of Ferricyanide slowly decompose on standing or use, which is accelerated by light. So to increase the life of a bleach solution, it should be protected from light, not only when storing, but when using.

Although a plain solution of Ferricyanide will bleach metallic silver (usually a 15% solution is used), bleaching is accelerated by adding bromide.

FERRICYANIDE & FERROCYANIDE -Continued-

In the presence of bromide ions, most, if not all, of the silver ions in the emulsion are converted in the bleach bath back to silver bromide and then removed in the fixing bath.

Ferricyanide bleaching is accelerated by having the solution slightly alkaline. In color photography, you will find acid, neutral or alkaline bleaches specified. Follow the recommendations for the type of emulsion you plan to process.

Ferricyanide in solution slowly decomposes to form inactive Ferrocyanide. Ferricyanide has been used for the last 40 years or more to bleach all types of color emulsions.

FORMALDEHYDE HCHO — MW 30.03

PROPERTIES: Clear, colorless liquid. Pungent suffocating odor. Use with ventilation. POISONOUS! FLAMMABLE!

FORMALIN: Formalin is a 40% solution of Formaldehyde Gas.

PHOTOGRAPHIC USES: Formaldehyde is used because of its ability to harden gelatin when used in an alkaline solution. It does not harden a gelatin (emulsion) when added to an ACID bath. The stronger the Formaldehyde solution, the faster the hardening action.

Formaldehyde is also used to stabilize the dyes formed in color emulsions. Those stabilizing solutions are not always alkaline.

DIETHYLENE GLYCOL $HO\text{-}CH_2CH_2O.CH_2.CH_2OH$ — MW 106.12

PROPERTIES: Colorless, hygroscopic, odorless.

SOLUBILITIES: Miscible with water, alcohol, ether, acetone or Ethylene Glycol.

TOXICITY: POISONOUS. Deaths have been reported from its uses as a solvent in an elixir.

PHOTOGRAPHIC USES: This chemical appears in a number of Kodak kits and is used in their color developing solutions. The use of Diethylene Glycol does help to facilitate the dissolving of Benzyl Alcohol (see Benzyl Alcohol).

ETHYLENE GLYCOL HO CH_2CH_2OH — MW 62.07

PROPERTIES: Hygroscopic. Absorbs twice its weight of water at 100% relative humidity.

SOLUBILITIES: Miscible with water, alcohol, Acetic Acid, Acetone, Aldehydes, Benzyl Alcohol.

TOXICITY: POISONOUS! Do not swallow.

PHOTOGRAPHIC USES: As a humectant in paper flatteners, etc. Has been used as a substitute for Diethylene Glycol in some Kodak color developers.

HYDROXYLAMINE HYDROCHLORIDE NH_2OH-HCl MW 69.50

PROPERTIES: Hygroscopic crystals. Keep well closed. Colorless.

SOLUBILITIES: Soluble in water, Glycerol, Alcohol, or Propylene Glycol. One gram dissolves in one ml of water. Slowly decomposes when moist.

An air oxidized color developer produces Hydrogen Peroxide and a dye as a color stain or fog. Hydroxylamine Hydrochloride is a reducing agent and is used in some developing solutions because it is more easily oxidized than the color developing agent.

Small traces of copper in color developers accelerate oxidation and contaminate the solution. Sometimes distilled water contains traces of copper (from copper stills), E.D.T.A. Disodium Salt can be used to sequester the copper, but E.D.T.A. is incompatible with Hydroxylamine Sulfate which is decomposed with the evolution of Nitrogen.

HYDROXYLAMINE SULFATE $(NH_2\text{-}OH)_2 \cdot H_2SO_4$ MW 164.15

PROPERTIES: Odorless white crystals or powder.

SOLUBILITIES: Freely soluble in water. Solution has corrosive action on the skin.

PHOTOGRAPHIC USES: See Hydroxylamine Hydrochloride above.

MAGNESIUM SULFATE $MgSO_4$-(anhy) or $MgSO_4\text{-}7H_2O$ MW 246.50

PROPERTIES: White crystal or powder.

PHOTOGRAPHIC USES: The action of this chemical in processing solutions is similar to Sodium Sulfate. It has the ability to retard the swelling of gelatin. This is a physical rather than a chemical reaction. It has been used as a hardening wash after color development.

Considering that distilled water should be used when making up developing solutions, the adding of Magnesium Sulfate (or Sodium Sulfate) to the solution will help retard swelling. Although they are photographically inert, it should be remembered that in large amounts, they do retard development.

6-NITROBENZIMIDAZOLE NITRATE (6NBN) $C_6H_3.NHCH:N\text{-}NO_2$

PROPERTIES: Stable tan powder.

PHOTOGRAPHIC USES: This is the same as Kodak's Anti-Fog #2. It was patented by Wulff (USP 1,697,930). Because this chemical is used in very small amounts as an Anti-Fog, primarily in color processing, the general procedure is to make a stock solution (such as 1. gram to 1,000 ml). This is equivalent to .001 gram per ml of stock solution. 6-Nitrobenzimidazole Nitrate dissolves with difficulty in water. The best procedure is to use hot water (175^oF) when compounding a stock solution.

PHOTO-FLO

This is a proprietary wetting agent manufactured by Kodak. It is available in a number of concentrations. Follow directions for use on bottle. The "600" is three times the strength of that available over the counter in photo shops.

POTASSIUM CARBONATE (Anhydrous) K_2CO_3 MW 138.20

PROPERTIES: Colorless, granular or crystal. Hygroscopic, keep tightly closed. pH of solution: 11.6.

SOLUBILITIES: One part in one part water. Insoluble in alcohol.

PHOTOGRAPHIC USES: Used in some developing solutions to form the alkali. It gives a higher pH than Sodium Carbonate.

SODIUM CARBONATE (Monohydrate) $Na_2CO_3H_2O$ MW 124.02

PROPERTIES: Odorless, white crystals. Stable. Decomposed by acids with effervescence, releasing CO_2.

SOLUBILITIES: One part in three parts water.

PHOTOGRAPHIC USES: Used as the alkaline activator in many black and white and color developers.

CONVERSION: 100. grams anhydrous is equivalent to 117. grams of the monohydrate.

SODIUM CARBONATE (Anhydrous) Na_2CO_3 MW 106.00

PROPERTIES: Odorless white crystals, hygroscopic. Combines with water with evolution of heat. Solutions have pH of approximately 11.6. Keep container closed.

SOLUBILITIES: One part in 3.5 parts water.

PHOTOGRAPHIC USES: Same as Sodium Carbonate, monohydrate.

There is also Sodium Carbonate, decahydrate, $Na_2CO_310H_2O$.

POTASSIUM ALUM ALK $(SO_4)_2 12H_2O$ MW 474.39

PROPERTIES: Colorless, odorless, powder or crystals. Stable if kept in closed container.

SOLUBILITIES: One gram in 7.2 ml of water (boiling water 0.3 ml).

PHOTOGRAPHIC USES: This chemical is used in fixing baths to harden the emulsion. It is not as effective as Chrome Alum, but it does retain its hardening ability for a much longer time.

Kodak's fixing bath F-5 which is used in a number of their color processing systems contains Potassium Alum.

KODAK F-5

Water (125^{O}F)	600.0	ml
Sodium Thiosulfate (anhy)	153.0	grams
Sodium Sulfite (des.)	15.0	grams
Acetic Acid 28%	48.0	ml
Boric Acid (crystal)	7.5	grams
Potassium Alum	15.0	grams
Cold water to make	1.0	liter

Because of the recent pre-factory hardening of both negative and reversal color films (process C-41 and E-6 types), Potassium Alum and Potassium Chrome Alum (see next listing) are unecessary.

POTASSIUM CHROME ALUM $CrK(SO_4)_2\ 12H_2O$ MW 499.43

PROPERTIES: Ruby-red lavender crystals or powder.

SOLUBILITIES: One part in four parts water. Only two parts in boiling water. Insoluble in alcohol.

PHOTOGRAPHIC USES: A solution of Chrome Alum will harden a gelatin emulsion. This action is very dependent on pH, which must not be over 4.7. This chemical is no longer used (see note above under Potassium Alum).

POTASSIUM IODIDE KI MW 166.02

PROPERTIES: Colorless crystals or white powder. On long exposure to air becomes yellow due to liberation of iodine. Solutions of Iodide turn yellow with time due to oxidation. Adding a small amount of Alkali will help prevent oxidation.

SOLUBILITIES: One gram dissolves in 0.7 ml of water. When making up a percentage solution, use deionized water and add one gram of Borax, so that solution is slightly alkaline. This will prevent decomposition. If the solution turns yellow, discard. We might also mention that Kenneth Mees of Kodak in his "Theory of the Photographic Process", 1954 edition on page 5, explains in part that small amounts of silver iodide are added to many emulsions and that the photographic properties are complicated "because the solubility

POTASSIUM IODIDE -Continued-

of silver iodide is lower than that of silver bromide, it tends to produce emulsions of fine grain and at low concentrations, it gives emulsions of higher speed and contrast than pure bromide emulsions of the same grain size. Since silver iodide is less readily reduced by photographic developers than silver bromide, emulsions containing large concentrations of iodide tend to withstand prolonged development and give lower contrast".

NOTES ON COLOR DEVELOPING

Agitation changes the rate of development (about 20%), the same as differences in time. Differences in agitation can change the speed, gradation and color balance.

Partial compensation can be had by variations of the Thiocyanate and Iodide concentration IN THE FIRST DEVELOPER. Practical tests with color film show that even a small concentration of Iodide exerts an appreciable restraining effect on the YELLOW and MAGENTA layers, giving an effective speed loss in these layers and a shift in the overall color-balance shifts that occur when a first developer is used. If small amounts of Potassium Iodide are added (3 to 6 milligrams) initially to the fresh developer, the color balance changes are reduced.

Under processing conditions where only moderate agitation is encountered, bluish-cyan color balances are often encountered because the first developer is most active on the top layers of the film and does not easily penetrate to the bottom layer. Increased first development times under such conditions do not change the relative rates of development in the layers. However, the maintenance of a higher than normal Iodide concentration will restrain first development in the top layers more than in the cyan layer, and by use of slightly longer than normal developing times, a normal color balance can be achieved.

For this reason, most of the modern COLOR DEVELOPING FORMULAS contain a very small amount of Potassium Iodide (2 to 12 milligrams).

POTASSIUM METABISULFITE $K_2 S_2O_3$ MW 222.32

PROPERTIES: White crystals, Sulfur dioxide odor, acid reaction.

SOLUBILITIES: Freely soluble, one part to three parts water. Insoluble in alcohol. Keep dry and tightly closed. Partially decomposed by HOT water, which should not be used when making up solutions.

SUBSTITUTIONS: Potassium Metabisulfite has the same uses as Sodium Metabisulfite or Sodium Bisulfite.

7 parts of Sodium Metabisulfite replaces 8 parts of Potassium Metabisulfite.

SODIUM BISULFITE (Anhydrous) $Na_2S_2O_5$

PROPERTIES: Free flowing white powder, colorless crystals.

Sodium Bisulfite powder can best be thought of as a chemical "container" for Sulfur Dioxide (SO_2), easily opened with mild acidulation.

Sodium Bilsufite should be stored in a cool, dry place. Contact with moisture results in caking of the product and a slow release of SO_2.

TOXICITY: Excessive contact with the skin should be avoided.

PHOTOGRAPHIC USES: Sodium Bisulfite finds some use in formulated "developer" solutions replacing part of the Sodium Sulfite. A more extensive use of Sodium Bisulfite is in the formulation of hypo fixing baths. Decomposition of the Sodium Thiosulfate in acid solution according to the equation $H_2S_2O_3$---H_2SO_3+ is MARKEDLY DECREASED BY THE ADDITION OF SODIUM BISULFITE.

POTASSIUM THIOCYANATE KCNS — MW 97.18

PROPERTIES: Colorless, transparent, odorless, hygroscopic crystals.

SOLUBILITIES: Soluble in water (1:1) with temperature drop.

PHOTOGRAPHIC USES: See Sodium Thiocyanate.

SODIUM THIOCYANATE NaSCN — MW 81.08

PROPERTIES: Colorless crystal or white powder. Affected by light.

IMPORTANT NOTE: Because Thiocyanate is hygroscopic, both Kodak and Lauder supply a stock solution of 1. ml of which contains .66 gram Sodium Thiocyanate (or 1.5 ml = 1. gram).

SOLUBILITIES: Very soluble in water, one gram in approximately 0.6 part water.

PHOTOGRAPHIC USES: In large amounts it acts as a silver halide fixer, like Sodium Thiosulfate (hypo), however, it also softens the emulsion. It is added to FIRST developers (both color reversal and B&W processing), in small amounts (one to two grams) to clear or dissolve the fine silver in the highlights. It has also been found that in very small amounts, it will act as a booster of development.

SODIUM ACETATE (Anhydrous) CH_3COONa — MW 82.04

PROPERTIES: White powder with no water of crystallization. The positive heat of solution of Sodium Acetate, Anhydrous, is an advantage in most cases where it goes into solution, since the resultant warming of the water increases the rate of solution.

SODIUM ACETATE -Continued-

SOLUBILITIES: Soluble in 2 parts water. A 10% solution of either grade gives a pH of 6.5 to 8.5.

PHOTOGRAPHIC USES: Sodium Acetate is a generally used buffer for pH control in photographic solutions.

Sodium Acetate has such marked buffering properties that the accidental addition of an excess does not raise the pH appreciably.

SODIUM BISULFATE $NaHSO_4$ MW 120.07

PROPERTIES: Colorless or white crystals. Solutions are strongly acid. Hygroscopic. Keep closed.

SOLUBILITIES: One part in two parts water. Decomposed by alcohol.

PHOTOGRAPHIC USES: General acid, giving a pH of approximately 1.5. Sodium Bisulfate may be used to replace Sulfuric Acid, 2.82 parts replaces 1 part by weight of pure Sulfuric Acid. In solution Sodium Bisulfate forms equal molecular parts of Sodium Sulfate and Sulfuric Acid.

SODIUM HEXAMETAPHOSPHATE (See Calgon)

SODIUM HYDROXIDE NaOH MW 40.01

PROPERTIES: Fused large flakes or beads. Rapidly absorbs CO_2 and water from the air. Very corrosive to animal and vegetable tissue. Stable if stored in air tight containers.

SOLUBILITIES: One gram in 0.9 ml of water generates considerable heat while dissolving. Solution should be stirred to prevent cracking glass container.

PHOTOGRAPHIC USES: Generally used to form alkali in developers. Sometimes used in conjunction with other alkalies. A 0.5% solution has a pH of approximately 13.

SODIUM METABORATE $NaBO_2 8H_2O$ MW 65.82

OTHER NAMES: Kodak's Balanced Alkali - Kodalk.

PROPERTIES: White crystals or powder.

SOLUBILITIES: Very soluble in water. Available with from one to eight molecules of water.

PHOTOGRAPHIC USES: Used to replace the alkali in a number of developers. It is a combination of Sodium Hydroxide and Borax. Among its many advantages is the fact that it does not release CO_2 as the carbonates and other alkalies will when an emulsion is placed in an acid stop bath.

SODIUM PHOSPHATE, DIBASIC (Anhydrous) Na_2HPO_4 MW 141.98

PROPERTIES: White powder. Hygroscopic. Keep container closed. On exposure to air, will absorb from 2 to 7 molecules of water.

SOLUBILITIES: One part to eight parts water. Insoluble in alcohol. 1% solution produces a pH of approximately 9.1.

PHOTOGRAPHIC USES: See Sodium Phosphate, Monobasic.

SODIUM PHOSPHATE, MONOBASIC $NaH_2PO_4 \cdot H_2O$ MW 138.01

PROPERTIES: White, odorless crystals or granules.

SOLUBILITIES: Freely soluble in water, practically insoluble in alcohol. A 5% solution produces a pH of approximately 4.5. In open container will slowly crystallize with $2H_2O$. Container should be kept closed.

PHOTOGRAPHIC USES: Used with Sodium Phosphate Dibasic to form buffered solution.

SODIUM PHOSPHATE, TRIBASIC $Na_3PO_4 \cdot 12H_2O$ MW 380.16

PROPERTIES: Colorless or white crystals.

SOLUBILITIES: Soluble in 3.5 parts water, 1 part in boiling water. Insoluble in alcohol. The solution is strongly alkaline. A 1% solution has a pH of 11.9.

PHOTOGRAPHIC USES: In developers as alkali or part of the alkali. When using Trisodium Phosphate, the solution should be made with distilled water or the formula should contain Calgon.

SODIUM SULFATE (Anhydrous) Na_2SO_4 MW 142.06

PROPERTIES: White powder, stable.

SOLUBILITIES: One part in 3.6 parts water. Solubility increases with temperature. Insoluble in alcohol.

PHOTOGRAPHIC USES: Sodium Sulfate is photographically inert. However, it is added to photographic solutions to help decrease the swelling of the emulsion. Because of the increased salt content of the solution, developing action is decreased.

NOTE: This chemical is not needed or used in C-41 or E-6 because the emulsions are factory pre-hardened.

SODIUM SULFITE (Anhydrous) Na_2SO_3 MW 126.06

PROPERTIES: Small white crystals. It is fairly stable.

SODIUM SULFITE (Anhydrous) -Continued-

SOLUBILITIES: It is very soluble in water. 3.2 parts to one part water. It has a pH of 7.5 to 9.0.

Crystalline Sodium Sulfite ($7H_2O$-MW 252.17) has been available in the past. One part Anhydrous being equivalent to two parts crystalline.

PHOTOGRAPHIC USES: Sodium Sulfite plays many roles in photographic processing. It is used in developer solutions as a preservative. That is, it retards the oxidation of the developing agents. At the same time, it prevents the air oxidation of the solution.

Sodium Sulfite acts as an accelerator of some developing agents while retarding the action of others. In formulas containing Metol (Elon), the majority of the Sulfite must be dissolved after the Metol or the Metol will refuse to go into solution.

In acid fixing baths, Sodium Sulfite is used to prevent the decomposition of Sodium Thiosulfate. It is used in hypo clearing baths as it accelerates the removal of hypo from an emulsion.

The history of this chemical goes back to about 1881 when H.B. Berkeley discovered that it would prevent the air oxidation of a solution of Pyro. Pyro or Pyrogallic Acid's history goes back to 1851 when it was used as the first black and white developing agent. The addition of Sodium Sulfite to a Pyro developer was a great discovery and has been used ever since for the same reason... TO PREVENT DEVELOPER OXIDATION!

There is one strange paradox. Sodium Sulfite probably set color photography back 25 years, because the oxidized Pyro will form a dye in a gelatin emulsion (yellow-brown), if the solution does not contain Sodium Sulfite. Even today, TOO MUCH Sodium Sulfite in any color developing solution will have the same effect--no color. Check the various color developing formulas and you will notice that the Sodium Sulfite content is always very low (usually under 6. grams).

AMMONIUM THIOSULFATE $(NH_4)_2S_2O_3$ MW 148.21

PROPERTIES: White crystals or clear liquid. Usually supplied as a 60% solution.

SOLUBILITIES: Very soluble in water. pH of 60% solution: 6.5 to 7.0.

PHOTOGRAPHIC USES: Test will show that maximum fixing with Ammonium Thiosulfate takes place in a fresh 15% solution. This chemical is the basis of most FAST ACTING HYPO SOLUTIONS. It is more rapid than a 35 to 40% solution of Sodium Thiosulfate.

AMMONIUM THIOSULFATE -Continued-

There is an old maxim that a film should be fixed twice the time of clearing. To test the time it takes to clear, use light-exposed old film (not developed). This test can be performed in normal room light. Check the temperature of the solution (fixer). With stop-watch or sweep second hand, place the film in the fixer solution and check the time it takes to completely clear the film. By clear, we mean completely transparent. Fixing should be continued (in practice) by doubling the time it takes to clear. As the fixer is used, it will slow down in use. When the above test takes twice the original time, the fixer should be discarded. This test also applies to Sodium Thiosulfate.

SODIUM THIOSULFATE (Anhydrous) $Na_2S_2O_3$ MW 158.13

PROPERTIES: Colorless, odorless crystals. Stable if the container's kept closed. The Anhydrous does not lower the temperature of the solution as does the crystal ($5H_2O$). The Kodak brand of Hypo is Sodium Thiosulfate ($5H_2O$) or Pentahydrate. 64 grams of the Anhydrous replaces 100 grams of the cryatal.

SOLUBILITIES: One part in 0.5 parts of water. Insoluble in alcohol. Solution slowly decomposes on standing. Solutions of plain Sodium Thiosulfate has a pH of 6.5 to 8.0.

PHOTOGRAPHIC USES: The first practical chemical used for fixing a photographic emulsion was Sodium Thiosulfate--it is still the most popular. By fixing, we mean, a solution of Sodium Thiosulfate has the ability to remove from an emulsion the silver salts which have NOT been changed to metallic silver by a developing solution. To remove developed silver, we must first change (bleach) the silver to a salt that is soluble in Thiosulfate (see Ferricyanide).

NOTES ON DEVELOPING AGENTS

For a number of years, Dignan Photographic supplied most of the chemicals needed to compound black & white and color processing solutions. This service was discontinued in 1974.

In our original catalog, we listed all of the developing agents by name and our code. DD stood for Dignan Developer. The numbers were from #1 to #19. Our code system produced confusion with one developer; our DD-4 was listed as Elon or Metol. We skipped to DD-25 for Kodak CD-4 (CD-4 was not available when our original catalog was conceived).

In this book we are listing three black & white developing agents and seven color developing agents. Most are available in small amounts from Lauder, Zone V and Porter Camera.

Perhaps DEVELOPING agents are the cause of more confusion to the novice than any other part of photographic chemistry.

A developing agent is a chemical that has the ability to develop or amplify the exposed silver halide of a photographic emulsion. It changes the light sensitive silver bromide to metallic silver. There are perhaps thousands of chemicals that could be used for this purpose, but there are only about a dozen used for most black & white and MOST COLOR FILMS AND PAPERS.

A developing agent must have a number of special properties. It must be economical to manufacture, stable as a powder and as non-toxic as possible. It must be soluble in water and not stain the emulsion. These are just a few of the requirements of a successful developing agent. Even the developing agents in use do not completely fulfill the requirements listed above.

DD-4 p-METHYLAMINOPHENOL SULFATE (SAME AS METOL, ELON, PICTOL)

$C_6H_4(OH)\ (NH\ CH_3)_{\frac{1}{2}}H_2SO_4$ MW 344.38

PROPERTIES: White needles or crystals. Discolors slowly in air. Also affected by light. Keep well closed and protected from strong light.

SOLUBILITIES: Metol is one chemical which is more soluble in cold water than hot. One part dissolves in 20 parts COLD water; 6 parts BOILING water.

Metol is one chemical which refuses to dissolve if too much Sodium Sulfite is present in the solution. It is usually recommended to add a pinch of Sulfite to the solution first and then dissolve the Metol. The small amount of Sulfite will prevent oxidation, but will not prevent the Metol from dissolving.

Metol is invariably used in combinations with Hydroquinone (DD-14) and the two are said to be super additives. In other words, development is greater with the two in combination than either used alone.

Some people are allergic to Metol, the solution producing dermatitis, similar to Phenylenediamine poisoning. In fact, it is traces of Phenylenediamine in the Metol which is actually the culprit. These impurities are difficult to eliminate in manufacturing. Phenidone (which is nontoxic) can be substituted for Metol in most formulas (see DD-5).

DD-5 1-PHENYL-3-PYRAZOLIDONE (PHENIDONE)

$C_9H_{10}ON_2$

PROPERTIES: Tan stable powder.

SOLUBILITIES: One gram dissolves in 10. ml of BOILING water.

The activity of Phenidone is very similar to that of Metol, but has many properties which make it more advantageous to use. It is non-toxic and although more expensive than Metol, only one-fifth to one-tenth as much is needed to produce the same results. Phenidone is much more soluble than Metol so that a more concentrated developer can be produced. Today a Phenidone/Hydroquinone combination is used in most prepared first developers for color reversal (instead of Metol/Hydroquinone).

DD-14 HYDROQUINONE

$C_6H_4(OH)_2$ MW 110.11

PROPERTIES: White crystals or needles. Darkens slowly on exposure to air and light.

DD-14 HYDROQUINONE -Continued-

SOLUBILITIES: One gram in 14 ml of water. Soluble in alcohol and ether.

OTHER NAMES: Hydrochinon, Hydrokinone, Quinol.

TOXICITY: Dermatitis may result from skin contact.

PHOTOGRAPHIC USES: Hydroquinone is mainly used in combination with Metol or Phenidone, in First Developer for reversal color processing.

COLOR DEVELOPING AGENTS AND THEIR SUBSTITUTIONS

The following seven developing agents are those in common commercial use as color developing agents.

Most of the following developing agents can be substituted, but it is not always possible to do this by just calculating the molecular weight and converting. There are many facts that influence the choice; compatibility with other chemicals in the formula; solubility; the type of emulsion, etc.

DD-1 N,N-DIETHYL-p-PHENYLENE DIAMINE SULFITE

$(C_2H_5)_2NC_6H_4NH_2\text{-}SO_2\text{-}H_2O$ MW 246.33

This chemical was patented by May and Baker (England) claiming that it has the following advantages when compared with diethyl-para-phenylene diamine hydrochloride (see DD-2). It does not oxidize as readily, so keeping properties are better as a solid or in solution. It is also less prone to give color fog.

Ferrania, of Italy, have officially recommended the following substitutions in their developer RC103: DD-1, 2.5 grams per liter (in this particular formula, the Sodium Sulfite Anhydrous was reduced from 2.5 grams to 1.5 grams per liter). If you wish to substitute N-DIETHYL-p-PHENYLENE DIAMINE SULFATE (DD-7) you could use 2.8 grams per liter, or you could use N,N-DIETHYL-p-PHENYLENE DIAMINE MONOHYDROCHLORIDE (DD-6) 2.2 grams per liter. Interchanging or substituting the above developing agents will not change the ultimate results of the dyes formed.

DD-2 N,N-DIETHYL-3-METHYL-p-PHENYLENEDIAMINE HYDROCHLORIDE (CD-2)

$NH_2(CH_3)C_6H_3N(C_2H_5)_2\text{-}HCl$ MW 214.74

This developing agent is primarily used in some of the Kodak color print developers.

This developing agent is more active than CD-3 and Kodak seems to be phasing it out slowly in favor of CD-3. We suspect the reason is primarily because it is more toxic.

DD-3 4-AMINO-N-ETHYL-N-(β-METHANE-SULPHONYL-AMIDO-ETHYL)-m-TOLUIDINE SULFATE MONOHYDRATE (CD-3)

$(CH_3SO_2NH\ C_2H_4C_2H_5)\ N\ C_6H_3CH_3NH_2 1/2\ H_2SO\text{-}H_4O_2$

This is the color developing agent used in most of Kodak's Official Color Processing Solutions. It is used in C-22, E-4, ME-4, P-122, CP-5, P-125, Eastman Color Negative film, etc.

PROBLEMS IN COMPOUNDING SOLUTIONS USING CD-3:

Care must be used when adding CD-3 to a developing solution. Using water at high or low temperatures, or adding the CD-3 to a concentrated solution of alkali, resulting in a high pH, can cause the following problem:

As the CD-3 is added, the free base of the CD-3 can precipitate. This in turn will catalyze more of the free base to form a black tar, which is insoluble in the solution.

Perhaps the simplest method to use when mixing a liter of color developer is to dissolve all of the components, except the CD-3. Add water and bring the total to 900. ml. At 75°F, in a separate graduate, add the CD-3 to 100. ml of water. When dissolved, the CD-3 solution should be immediately, but slowly, added to the previously compounded 900. ml solution, forming the complete color developing solution.

DD-25 4-AMINO-3-METHYL-N-ETHYL-N-(BETA-HYDROXYETHYL) ANILINE SULFATE (KODAK CD-4)

PROPERTIES: Tan to brown powder. More expensive than CD-3. We originally listed CD-4 as DD-25 (Dignan Developing agent).

This developing agent is more active than CD-3. It is more soluble and is not as susceptible to "tarring out" as CD-3. At the present time, the Kodak official C-41 processing system uses CD-4.

DD-6 N,N-DIETHYL-p-PHENYLENE DIAMINE MONOHYDROCHLORIDE (CD-1)

$(CH_3H_5)_2NC_6H_4NH_2\text{-}HCl$ MW 200.71

This developing agent was used in the past for processing Ansco film. It is still recommended officially by Agfa-Gevaert, however, they also list as a substitution DD-7 or DD-8. Also used by Kodak and other manufacturers in color print developers.

DD-6 -Continued-

COLOR DEVELOPER GEVAERT (G21)

Calgon	1.0	gram
Sodium Sulfite (anhy)	4.0	grams
Sodium Carbonate (mono)	60.0	grams
Potassium Bromide	0.5	gram
Hydroxylamine Sulfate	1.4	grams
AFTER ADDING DEVELOPING AGENT		
Water to make	1.0	liter

pH: 10.6 to 10.8

BEFORE USE, ADD ANY ONE OF THE FOLLOWING COLOR DEVELOPING AGENTS:

OFFICIAL SUBSTITUTION:

Diethyl-para-phenylene diamine Sulfate	3.6	grams (DD-7)
OR		
Diethyl-para-phenylene diamine Hydrochloride	3.0	grams (DD-6)
OR		
Ethyl-Ethyl Hydroxy-para-Phenylene-Diamine Sulfate	6.0	grams (DD-8)

DD-7 N-DIETHYL-p-PHENYLENE DIAMINE SULFATE

$(D_2H_5)_2NC_6H_3CH_3NH_2$-1/2 H_2SO_4

When substituting DD-7 for DD-6, (see formulas above) note that the formula calls for 6/10 of a gram more than DD-6. Some formulas call for the direct substitution on a one to one basis or from 1/10 to 6/10 of a gram more of DD-7. So if you want to experiment substituting DD-7 for DD-6, we would suggest that you start with the same amount and increase it 1/10 of a gram at a time.

DD-8 ETHYLETHYL HYDROXY PARAPHENYLENE DIAMINE SULFATE

$C_2H_4OH.C_2H_5NC_6H_4$-NH_4-1/2 H_2SO_4

DD-8 was patented by Ansco and is now used officially in Ansco's Film Processing Solutions. It is less active, but less toxic than most of the phenylene diamines, so when using this developing agent, a larger amount is needed to produce an effective developing solution. (For substitutions, see DD-6, above.)

* * *

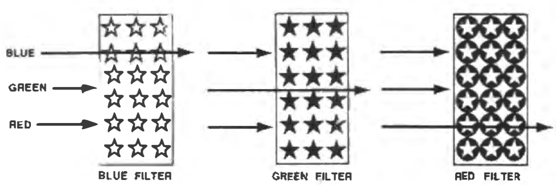
"When Magenta Add Magenta."

BY: PATRICK D. DIGNAN

If you have ever done subtractive printing, you know that the above statement is correct. But do you know in your mind's eye why it works? If you really feel you understand it, we suggest that you skip this article.

Without resorting to complicated mathematics, physics or chemistry we will try to explain why that color negative of yours contains all those strange colors. We will also attempt to explain exactly what happens when you change your filter pack in an attempt to correct the color balance when making a color print.

All our science text books explain that the visible spectrum can be divided into three PRIMARY colors, BLUE, GREEN & RED, and that by adding these three together we can reproduce all colors, including white. The most important properties to remember about *primary additive colors* are revealed in the following diagram.



Each primary filter PASSES ONE COLOR AND STOPS THE OTHER TWO. *If you attempt to overlap any two of the three, the result is black.* To use the primary additive colors in a photographic system, the colors must be added separately. In other words, you must have three separate sources of light. They must be projected and used separately. They cannot be superimposed at the source, only at the *screen.*

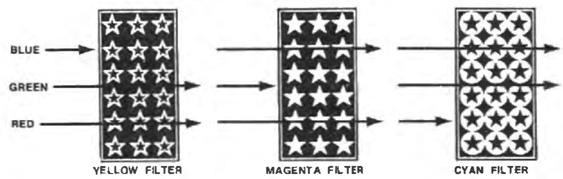
Your color TV set is one of the few commercially successful photographic color systems that uses the additive process. Placing a magnifying glass close to the screen will reveal that it is composed of minute individual blue, green and red dots.

The primary colors cannot be used in any modern color emulsion that relies on superimposing the three layers, and all of them do. This applies to film, whether it be negative, positive or reversal. It also applies to paper, whether it be positive or reversal. If the above is so, why is it that ALL color emulsions are made sensitive to the additive primaries: blue, green and red?

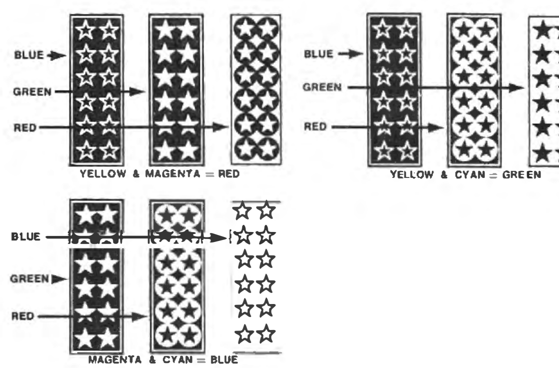
A color emulsion may contain six or seven different thin gelatine layers, coated on a plastic base. When you consider that the total thickness of all the layers is less than the thickness of a human hair, you can begin to understand that we are talking about a modern manufacturing miracle. Each layer must be coated to very close tolerances or the characteristics of the complete emulsion would produce very inconsistent results.

A color emulsion has *three main layers,* each containing light sensitive silver halides (that's right, just like all black-and-white film and paper). The top layer in most emulsions is *blue sensitive only.* This is done by choosing specific types of silver halides and adding a chemical which is referred to as an "optical sensitizer". Under this blue sensitive layer is a yellow filter which prevents blue light from penetrating to the lower layers. The middle layer is made sensitized to green light, the bottom layer is sensitized to red light. *The important thing to remember about ANY color emulsion is that the blue, green and red light are each recorded in a separate layer.* However, these are not the colors that are finally reproduced, and one reason for this, as we pointed out above, is that when any two of the primary colors are superimposed, the results produce black.

Fortunately for photography, there is another set of colors that can be used; these are called the SUBTRACTIVE PRIMARIES. They are YELLOW, MAGENTA AND CYAN. We all know what yellow looks like, but becoming familiar with magenta and cyan poses a slight problem. Magenta is a purplish red and cyan is a greenish blue. These three colors have properties that are the exact opposite of blue, green and red.



The important thing to remember about the subtractive colors is this: instead of letting one additive primary color pass, the *subtractive colors let two additive primary colors pass.* Combining two different subtractive color filters will produce one of the additive primary colors.



They are called subtractive because they subtract one of the additive primaries. The subtractive colors are also called complementary, for the following reasons:

A blue filter passes blue; a yellow filter stops blue.

A green filter passes green; a magenta filter stops green.

A red filter passes red; a cyan filter stops red.

The next question might be "how are color emulsions that are made sensitive to the primary colors converted into the subtractive colors—yellow, magenta and cyan—and how are these colors produced?"

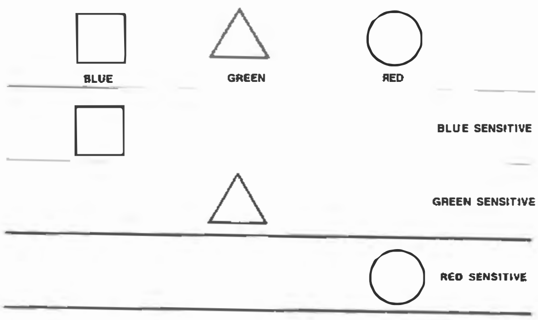
We explained that a color emulsion contains silver halides and that special chemicals are used to sensitize the three separate layers. To produce the needed color, another special chemical is added to each emulsion layer. This chemical is called a "color coupler".

The top blue sensitive layer contains a "color coupler" which under the proper conditions will change into a *yellow dye*. The exposed emulsion is placed in a developing solution that contains another special chemical called a color *developing agent*. This chemical changes the exposed silver halides to silver (just as in black-and-white), but the product of this reaction also changes the color coupler to a *yellow dye*. This reaction takes place only where the silver halide was exposed.

The green sensitive layer contains a color coupler that forms magenta. The red sensitive layer contains a color coupler that forms cyan. In each case, the *same* color developing agent in the developing solution reacts with the couplers to form the three different dyes.

It should be pointed out that after the color negative is color developed, the emulsion cannot yet be used, because it not only contains three dye layers, it also contains unexposed silver halides and developed silver. These have done their job and must be removed before the negative is usable. A fixing solution similar to that used to fix black-and-white emulsions will remove the unexposed silver. To remove the developed silver, it must be converted into a silver salt that is removable by the fixer. A ferricyanide bleach accomplishes this task and the fixer then removes the silver by-products. *The point to remember is that when processing a color emulsion, all the silver must be removed leaving only the three dyed layers.*

When you look at a black-and-white negative, it is not difficult to understand the reverse conditions that exist. Assume you expose your film to a white square. When the negative is developed, the white square will turn black. When this negative is placed in your enlarger, the black square *holds back the light*, the paper is not exposed, so upon development of the paper, that section of the picture will remain white. But to equate this concept to color is difficult.

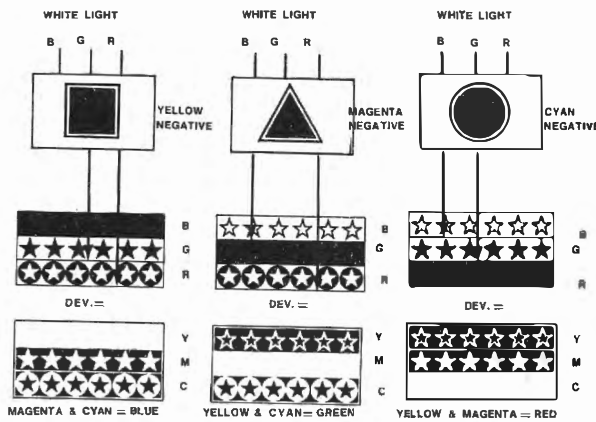


Let's assume that we have photographed three objects. The blue square will be recorded in the top blue sensitive layer, the green triangle will be recorded in the middle green sensitive layer and the red ball will be recorded in the bottom red sensitive layer. When color developed, the negative will contain:

These are the colors that will be used to expose the paper.

How does color print paper work? just like color film. It contains three main blue, green and red sensitive layers and they form yellow, magenta and cyan dyes.

Now let's put our color negative with the yellow square in our enlarger and see what happens.



The blue square color developed to yellow in the negative. Yellow stops blue but passes green and red. This exposes the green and red layers in the paper. The green layer develops to magenta, the red layer develops to cyan (magenta + cyan = blue).

The green triangle color develops to magenta in the negative. Magenta stops green but passes blue and red. This exposes the blue and red layers in the paper. The blue layer develops to yellow, the red layer develops to cyan (yellow + cyan = green).

The red ball color develops to cyan in the negative. Cyan stops red but passes blue and green. This exposes the blue and green layers in the paper. The blue layer develops to yellow, the green layer develops to magenta (yellow + magenta = red).

Our very first sentence should be clear, "If magenta, add magenta". What happens when we add magenta? Magenta stops green light, so it will reduce the exposure in the middle green sensitive layer. The green sensitive layer, when color developed, will produce less magenta.

This article will never get you into color balance, but if you are using subtractive filters in your enlarger, it should help you to understand the theory behind the system. If you are additive printing, you should now understand why you give the paper three separate exposures and why these filters are blue, green and red.

HOW TO WIN AT COLOR PRINTING

Benjamin R. Briggs

After that first monumental achievement you sink quivering and exhausted into your chair... By George, you did it! You put a piece of photographic paper under the enlarger, you exposed it, you ran it through those solutions at plus or minus one-half degree Fahrenheit--and wonder of wonders you got a color print with a blue sky and 10 to 1 a pretty girl in a polka-dot bikini...or perhaps not.

That's enough for one night. Take a stiff drink and go to sleep and dream of a one-solution color process.

But take a look tomorrow at that same color print. O.K. You can take it. You've had a night's rest. The sky isn't that color---who ever heard of a green sky? And green girls with green hair are in pretty short supply. You have a Green Cast. Fortunately it isn't an incurable disease. You may simply retire to the suggestion books put out by Agfa, Kodak, et. al., and learn by rote that you can correct a green cast by subtracting magenta from your color pack.

On the other hand, you might prefer to learn a little bit about the truly remarkable and fascinating processes involved in making a color print. Even a rather casual understanding of the process may help in evaluating and correcting the yellow, magenta, and cyan striped gremlin of the darkroom known as a Color Cast.

The process which you use to make color prints is known as the subtractive process, based on a suggestion made by Ducos du Hauron in 1862 and made practical by Kodak in 1935 by the development of the Kodachrome process.

So--why a subtractive process?

To explain this process and at the same time show that, despite its faults, the subtractive process is the only practical way to obtain a color print, we have included a little one page coloring book. If you follow it through and actually color it with your little girl's set of crayons, you will be rewarded not by the grand prize of six complete sets of color casts but by a better understanding of the process you are working with.

The basis of any color reproduction process was the demonstration by Clerk Maxwell in about 1855 that the colors of nature could be duplicated by a photographic process. He took identical photographs through a red, a green, and a blue filter and then made positive transparencies from each of the resulting negatives. By placing each of the positive transparencies in a separate projector before which was placed the same filter through which the negative had been made and superimposing the images from the three projectors, he was able to see for the first time a colored scene reproduced entirely by mechanical means. Most remarkable of all was the fact that although the only source of light on the screen was from colored filters, nevertheless there were white areas in the projected image. Maxwell already knew that the light from a red, a green, and a blue filter projected one over the other would produce white light, but this experiment demonstrated for the first time that color photography was possible. This process is called additive because the colors are added together from three projectors to produce a colored scene. A moments reflection will show that a red rose would produce a nearly clear area on the positive from the red filter negative. This area would, of course, be red on the screen. Any black area would be black in all three positive and hence black on the screen.

Color photography in 1855 left something to be desired in simplicity. What was needed was a means of putting dyes in the emulsion. But the dyes that must be placed in the emulsion could not be the red, green, and blue that had been shown to be able to duplicate all the colors of nature. Consider what would happen if we simply took Maxwell's positive transparencies, dyed them the proper color, and carefully assembled them together so that they were in perfect register and put them in a projector. The red rose would be blotted out in the green and blue transparency which would be black in the red rose area. In fact, for reasons that we shall soon see, this scheme of photography would be limited to such subjects as black cats prowling the streets of New York on Nov. 10, 1965. Hence the subtractive color process which uses instead of red, green, and blue, dyes known as cyan, magenta, and yellow, or less familiarly as minus red, minus green, and minus blue.

Why not a red dye? A red dye would absorb all other colors of the spectrum and allow only red to pass. So a combination of red, green, and blue dyes blots out all colors and leaves only black. But cyan can be described as minus red or blue-green, which means that it transmits both green and blue. Magenta is red-blue (transmits red and blue but stops green). So if an area in the film or paper contains both magenta and cyan, red and green are absorbed and blue is transmitted. By following through our coloring exercise you will see how each color as well as black and white are produced.

To better demonstrate the nature of white light, we have shown light passing through a prism where it is broken up into the familiar spectrum or rainbow. To simplify the picture we have shown only the red, green, and blue light which Maxwell showed were all that was required to produce white or any other color found in nature.

Next we coat three emulsions on a film base, each one sensitive to only one of the required three colors. Thus when red light strikes the red sensitive emulsion, developable silver is produced. The red rose is recorded on this single layer of the film. The red light passes through the green and blue sensitive emulsions without affecting it. Similarly, the leaves of the rose are recorded on the green sensitive layer and the blue sky on the blue sensitive layer. As you follow this diagram, color it with appropriate crayons. Participation is a remarkably effective way of learning ---So please, color our coloring book.

The chemistry of the process is extremely complex when we place this exposed silver in a color developer. But rather than become involved and perhaps sidetracked, let's leave the chemistry for another time. Suffice to say, the action of the developer causes an appropriate dye to form in each of the color sensitive layers. The dye formed is the complement of the color to which the layer is sensitive, hence we call this a negative color process. Transparency films undergo exactly this same negative state. Indeed, films such as Ektachrome may be satisfactorily developed and used as negatives. Thus the green sensitive layer of film releases a red -blue dye called magenta. The blue sensitive layer releases yellow, and the red sensitive layer releases cyan.

You may have some problems deciding how to color these minus colors. Pigments in crayons are quite different from the transparent dyes with which we are dealing. Do your best and we will understand.

The rest of the drawing should be more or less self-explanatory. The order in which the layers are coated on film and paper differ among different manufacturers, so the order of these layers is not meant to be correct. It may be well to point out that the colors in a color print comes from the white light reflected from the paper base and filtered by passing through the dyes in the emulsion.

There is one point of considerable importance in color reproduction which should be mentioned. We have implied in this drawing that the magenta, yellow, and cyan dyes are perfect, transmitting only the color they are supposed to. This is far from the facts. The yellow dye is the only one that is nearly ideal, in that it transmits almost all green and red and holds back all blue. The situation with magenta and cyan is not nearly so favorable. Both fail to transmit all the colors they should, and at the same time they transmit the colors they should withhold. The effect of this can be seen by examining the diagram. Consider the single effect of the failure of cyan to pass all the green. The production of magenta by the green sensitive layer in the paper is reduced and this loss of magenta will result in contamination of the red by blue reflected from the paper base. It is instructive to follow through to the consequences of other color errors. Kodak arrived at an ingenious solution to this problem by a system of intergral masks incorporated into Kodacolor and Ektacolor film. The defective dye layers form positive masks in proportion to the dye used in image formation. This accounts for the orange color of Kodak negative film. Although there can be no question that this intergral masking improves color fidelity, the question can also be raised: Is it worth the inconvenience it introduces? Transparency films do without the masks and have remarkably good color. Agfacolor negative film has no such mask and produces very acceptable results. And unmasked films can produce good black and white prints without resorting to an inconvenient panchromatic projection paper.

If you want to check this out, shoot a roll of High Speed Ektachrome at about ASA 600 and develop it exactly like Kodacolor. When you print it you may find some problems with flesh tones, but on the credit side you will find remarkably saturated and brilliant colors.

So what do you do about the Color Cast?

Here is a slogan for your darkroom wall.

ADD THE COLOR OF THE CAST OR SUBTRACT ITS COMPLEMENT FROM THE COLOR PACK.

Here is the chart just to be sure. We could have given you this at the beginning and let it go at that---but isn't it more fun to know what you are doing?

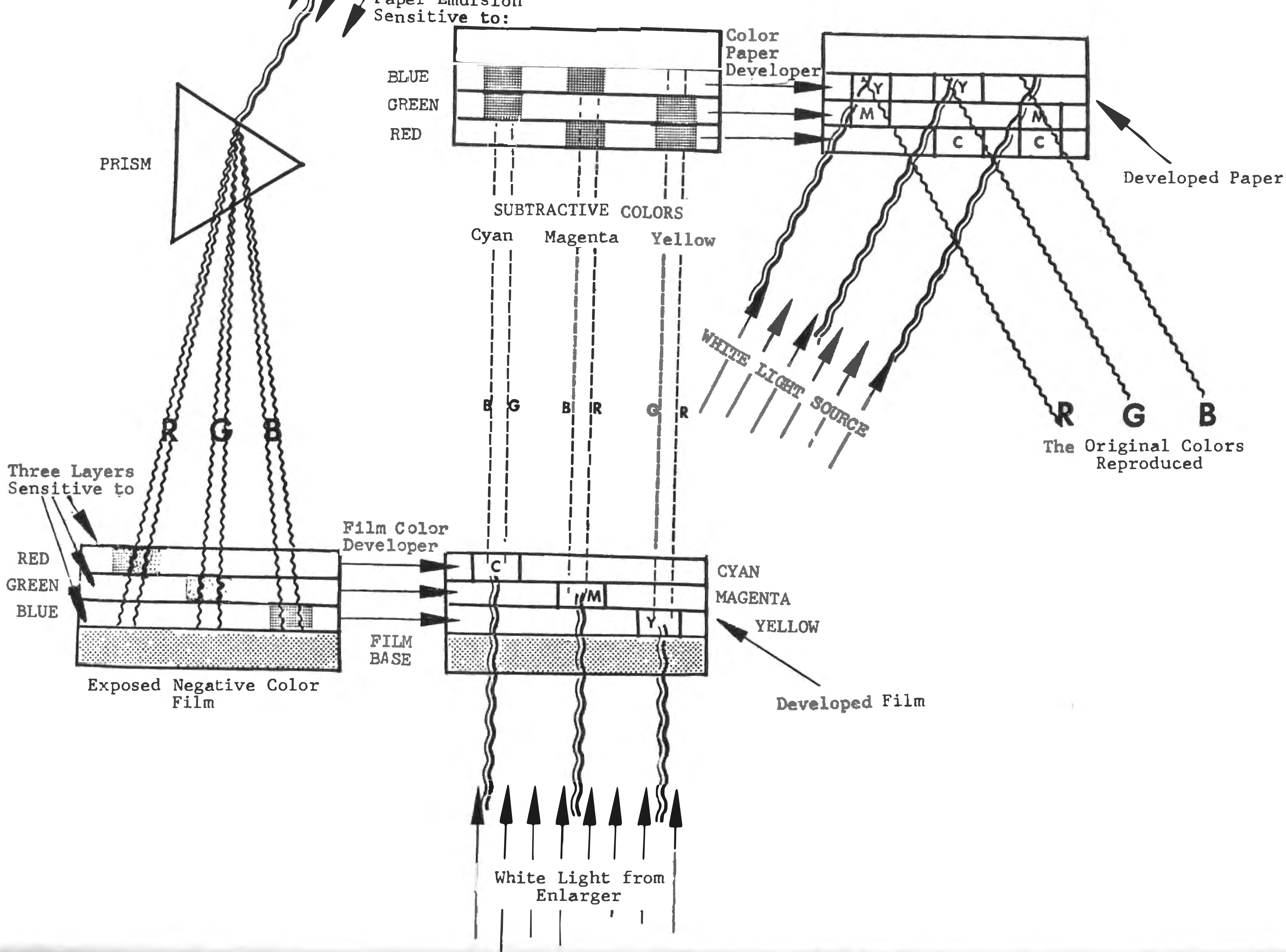
Color Cast	Subtract	Or Add
Magenta	Green or cyan and yellow	Magenta
Yellow	Blue or magenta and cyan	Yellow
Cyan	Red or yellow and magenta	Cyan
Red	Cyan	Red or yellow and magenta
Green	Magenta	Green or cyan and yellow
Blue	Yellow	Blue or magenta and cyan

Now another suggestion which may prove helpful. As soon as you have a color print with which you are completely satisfied, preferably one with both flesh tones and a gray area, use this negative and the same batch of paper and deliberately introduce a color cast by reversing the procedure in the above chart. Try about a 10 factor in each. Keep these pictures handy when you are color printing. You will find it especially helpful in distinguishing cyan from blue.

Sometimes you may even find color casts you like better than the more accurate and faithful color you have struggled so hard to produce. Movies often use deliberate overexposure and a blue cast to suggest night even though the scene is shot in broad daylight. You may use red to suggest warmth just as blue suggests cold. So experiment! Getting there is all the fun.

Also place both an incandescent and a fluorescent light source over the area where you evaluate your prints. Turn them both on simultaneously. If you use Agfa paper you can usually evaluate the color after the bleach step. Some subtle changes take place even in this paper on drying but generally they are not significant.

• • • • • •


Paper Emulsion
Sensitive to:
BLUE
GREEN
RED
Color
Paper
Developer
Y
Y
M
M
C
C
Developed Paper
PRISM
SUBTRACTIVE COLORS
Cyan
Magenta
Yellow
WHITE LIGHT SOURCE
B
G
B
R
G
R
R
G
B
R G B
The Original Colors
Reproduced
Three Layers
Sensitive to
RED
GREEN
BLUE
Film Color
Developer
C
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Y
CYAN
MAGENTA
YELLOW
FILM
BASE
Exposed Negative Color
Film
Developed Film
White Light from
Enlarger

SUBSTITUTE FORMULAS FOR AGFACOLOR PROCESSING OF MCN III PAPER

Agfacolor	Drum 86°f	Drum 77°f	Tray 77°f	Tray 68°f
Pre-Soak	30 sec.	30 sec.	none	none
Developer*	1:10 mins.*	2:30 mins.*	3:30 mins.*	5:00 mins*
Rinse	10 sec.	30 sec.	45 sec.	2:30 mins.
Stop-Fix	1:10 mins.	1:15 mins.	1:45 mins.	5:00 mins.
Lights on				
Rinse	10 sec.	30 sec.	30 sec.	1:00 min.
Bleach Fix	3:00 mins.	3:00 mins.	3:30 mins.	5:00 mins.
Wash	2:00 mins.	2:00 mins.	7:30 mins.	10:00 mins.
Stabilizer	1:00 min.	1:00 min.	1:45 mins.	3:00 mins.

Processing of any emulsion (paper or film) is a function of time, temperature and agitation. Increasing the temperature of any solution increases the chemical action of the solution.

When processing color paper, the main control must be given to the developer, rinse (or stop-bath depending on system used) and placing the paper in the stop-fix, which not only stops development, but also removes the unexposed silver - because the stop-bath (or stop-fix) and the remaining solutions, work to completion - extending the time somewhat will not alter the results.

SUBSTITUTE FORMULAS FOR AGFA RAPID PROCESSING

Water (95°f)	700.0 cc
Calgon	2.0 grams
Sodium Sulfite (anh.)	4.0 grams
Hydroxylamine Sulfate	1.4 grams
Color Developer DD-8**	5.0 grams
Potassium Bromide	1.0 grams
Potassium Carbonate	100.0 grams
6-Nitrobenzimidazole Nitrate (.2% solution)	3.0 cc
Sodium Hydroxide	1.1 grams
Water to make	1.0 liter (1000. cc)

pH: 10.9 to 11.0

**Instead of DD-8, you can substitute DD-6, using 2.5 grams.

NOTE: To make .2% solution, add 2.0 grams to 1000 cc of water.

The developing stock solution can be extended if it is mixed and stored without the developing agent. It will keep at least 4 months in fully filled stoppered glass bottles. With developing agent added, the life of the unused solution is approximately 3 weeks. For consistant results, the complete solution with developing agent, should be mixed and aged at least 24 hours before use.

*Although these developing times are considered normal, slight changes in contrast may be obtained by varying development times. A shorter time will give less contrast, a longer time will give more contrast.

AGFA STOP-FIX

Water (95°f)	700.0 cc	
Sodium Thiosulfate (anh.)	128.0 grams	
Sodium Sulfite (anh.)	10.0 grams	
Potassium Metabisulfite	25.0 grams	
Water to make	1.0 liter	(1000. cc)

pH 5.7 $\pm$ 0.1

Keeping properties unused: 4 to 6 months.

SUBSTITUTE FORMULA FOR BLEACH-FIX PPa III/K

Water (95°f)	700.0 cc	
EDTA Na_4	5.0 grams	
EDTA Ferric Salt	50.0 grams	
Sodium Carbonate (mono.)	2.0 grams	
Sodium Sulfite (anh.)	10.0 grams	
Sodium Thiosulfate (anh.)	130.0 grams	
Potassium Iodide	1.0 gram	
Water to make	1.0 liter	(1000. cc)

pH 6.8. Adjust pH with Carbonate to pH 6.6 - 6.8.

Keeping properties unused: 6 months

SUBSTITUTE FORMULA FOR STABILIZER Pa VI/S

Water (95°f)	700.0 cc	
Tinopal BHS (brightening agent)	2.0 grams	
Sodium Phosphate, monobasic	6.0 grams	
Sodium Phosphate, dibasic $7H_2O$	1.5 grams	
EDTA Na_4	2.0 grams	
Formalin 40%	30.0 cc	
Diethylene Glycol	20.0 cc	
Water to make	1.0 liter	(1000. cc)

pH 6.2 - 6.8.

Keeping properties unused: 1 year

NEW COLOR PRINT DEVELOPER FOR RAPID PROCESSING AGFACOLOR MCN-111 AND RC 37/74

BY PATRICK D. DIGNAN

A patent by Jacob Quentin Umberger, assigned to E.I. du Pont dated December 14, 1971 (USP 3,627,530) is the basis of the following formula information.

If you have been involved with color processing for very long, you have learned that sodium sulfite is always used in small amounts when compounding a color developing solution. The sulfite prevents the formation of the oxidation by-products, which can inhibit coupling.

This statement is not necessarily so. It not only depends on the couplers in the emulsion; it also depends on the total composition of the developing solution, as you shall soon see.

It may be helpful to realize that even the color chemist working in those giant photographic companies cannot put all those pieces together that make up our "humpty-dumpty" emulsions and processing solutions.

Although this patent is intended to cover the processing of radiographic x-ray emulsions, it does list an experiment which we have tried and found valuable when processing color print paper, although we did modify the procedure.

The experiment refers to a developing solution for the processing of AGFACOLOR MCN-111 paper in a developer of the following composition:

2-(p-amino-N-ethylanilino)ethanol sulfate*	9.0	grams
Sodium Sulfite (anhy)	40.0	grams
Potassium Bromide	2.0	grams
Sodium Hydroxide	16.0	grams
Water to make	1.0	liter

*Substitute DD-8 (ethyl ethyl hydroxy paraphenylene diamine sulfate).

The final pH was adjusted to 13.0 with a dilute aqueous solution of sodium hydroxide. Developing time was 20 seconds at 80°F.

This simple formula does work. The very high sulfite content is practical if the pH of the solution is pH 13.0 or above.

This method also opens up a vast area of experimentation. We think it is possible to modify almost any color print paper kit by increasing the sulfite and sodium hydroxide content. We compounded the following developer for Kodak RC-37/74 paper which functioned satisfactorily.

Water	800.0	ml
Benzyl Alcohol	15.0	ml
Sodium Sulfite (anhy)	40.0	grams
DD-8**	10.0	grams
Potassium Bromide	2.0	grams
Sodium Hydroxide	18.0	grams
Water to make	1.0	liter

** ethyl ethyl hydroxy paraphenylene diamine sulfate.

We used this at 75°F for one minute in a Unicolor drum. We rinsed for 30 seconds and then used a stopbath for two minutes. Blixing was done in a tray. This solution changed color balance, but no speed or contrast loss and no fog was present.

The patent claims that the results are due to the high pH, which allows the use of a large amount of sulfite.

Perhaps the thought occurs: Can this type of solution be used with transparencies? We would assume so, but we have not tested it.

One last important fact: The patent claims that any pH between 12.5 and 15.0 can be used. This simplified attempting to measure the pH, and this is a good thing, because pH in this high range is difficult to measure even with the best of equipment.

WARNING: THIS SOLUTION IS HIGHLY CAUSTIC. UNDER NO CONDITION SHOULD YOU PLACE YOUR HANDS IN THIS DEVELOPER. SODIUM HYDROXIDE CAN CAUSE SEVERE BURNS IF SPLASHED IN THE EYES. WASH WITH PLENTY OF WATER AND GET MEDICAL ATTENTION IMMEDIATELY.

ONE-SHOT COLOR PRINT PAPER FORMULAS

Basically, there are ONLY two types of color print paper manufactured. One is the Kodak type paper, "Ektacolor". This paper contains color couplers incapsulated in "oily rosin globules". It is recognizable when wet because it has a cyan opalescence which prevents analysis of color balance before it is dried. Also note that the color developer always contains Benzyl Alcohol, which is used to accelerate penetration of the developer into this type of emulsion.

The second group of color print papers are ALL based on the original Agfa Patents. These were confiscated at the end of World War II, as war reparation. Agfa uses an entirely different system of immobilizing the color couplers. They invented what is known as "long chain" or "heavy molecule dye couplers". The weight of these couplers has been increased to a point that makes them physically immobilized when placed in the emulsion gelatin. Perhaps we should point out that the objective of both the Kodak and Agfa systems are to prevent the dyes produced during color development from migrating within the gelatin.

The Agfa type emulsion is easily distinguished from Ektacolor type papers in that the color balance at the end of processing the Agfa type will appear almost the same as the dried print. The slight color shift before drying, is primarily due to the swollen condition with multiple emulsion.

"One-shot" formulas mean just that, they are meant to be used once and then discarded. Compounding one-shot formulas makes it possible, in many cases, to leave out certain chemicals or reduce the amount of a chemical necessary in the formula.

Tank or machine chemistry is compounded with an entirely different idea in mind. The longevity of each solution is of prime importance so a more sophisticated or complicated solution is needed.

Two solution processing to be used in the Kodak Drum, or in the Unidrum, Beseler, etc., to process Agfacolor MCN-111:

	Drum 100°F*
Pre-soak	30 seconds
Developer	45 seconds
Rinse	10 seconds
Bleach/Fix	2 minutes
Wash	2 minutes

*Although these developing times are considered normal, slight changes in contrast may be obtained by varying development times. A shorter time will give less contrast; a longer time will give more contrast.

ONE-SHOT COLOR PRINT PAPER FORMULAS (continued)

COLOR DEVELOPER

Solution "A"

Water (80 - 90°F)	600.0	ml
Potassium Bromide	1.0	gram
Potassium Carbonate (anhy)	100.0	grams
Water to make	700.0	ml

Solution "B"

Water (80 - 90°F)	100.0	ml
Sodium Sulfite	3.0	grams
DD-8**	5.0	grams
Water to make	200.0	ml

**Ethylethyl hydroxy paraphenylene diamine sulfate.

Add solution "B" to solution "A" slowly with stirring. Then add water to make a total of 1 liter. The complete solution will have a slight yellow tinge.

BLEACH/FIX

Water (80 - 90°F)	600.0	ml
Sodium Sulfite (anhy)	10.0	grams
Sodium Bisulfite	20.0	grams
E.D.T.A. Na4	5.0	grams
E.D.T.A. Ferric Salt	25.0	grams
Ammonium Thiosulfate (60%)	200.0	ml
Water to make	1.0	liter

* * *

FOUR SOLUTION PROCESSING OF EKTACOLOR PRINT FILM

By Patrick Dignan

There are two transparency films available from Eastman Kodak which are little used by amateurs and certainly not enough professionals take advantage of these emulsions. These two films are called Ektacolor Print Film and Ektacolor Slide Film.

We recently experimented with one of these emulsions, Kodak Ektacolor Film 4109. We purchased a box of 5x7 containing 10 sheets for $16.16 plus tax. When a large transparency of a negative is required, these films should be considered.

In the graphic arts field, it is customary when reproducing a color picture, to work from a reversal original such as an Ektachrome. We believe this is rather an antiquated system. The main reason it is perpetuated is because it gives the art director an original for comparison with the results when the picture is printed on paper.

It would seem to us that a much simpler method would be to use negative color in the camera, make an enlarged transparency using Ektacolor Print Film. The master positive separations could be made directly from the negative. In fact, Kodak recommends this system using Kodak separation negative film.

Although the Kodak Ektacolor Print Film package contained only one page of information, it was sufficient to process an exceptable print on our first try. Yes, we were surprised and of course pleased. We followed the sheets recommendations for filtration and exposing. The filter combination varies with the individual emulsion numbers. Our sheet suggested 10 seconds using 60 magenta plus 70 yellow, with an increase in exposure from normal of 1/3 of a stop.

The method for success in compounding photographic solutions for commercial processing is to first use the official recommended kit or formulas and stick to the procedure. In this case the recommended process is C-22 with 11 minutes in the developer at 75°. After working so long with Kodacolor II with the developer at 100° for 3 1/4minutes, 11 minutes in the developer seemed like an eternity. To shorten the system we utilized a 2% acetic acid stop bath for one minute and three minutes in an EDTA ferric ammonia thiosulfate bleach/fix.

We were surprised that the bleach/fix worked as rapidly as it did on the emulsion. It cleared in about one minute. We judged bleaching and fixing by holding the processed film up so that we could look at it through a No. 10 filter. Presumeably this happens because this emulsion is made of a very fine dispersion of silver. If you decide to process this emulsion, do so with care because it is extremely soft and easily scratched. A wash and formaldehyde stabilizer completed the process. It doesn't take too much ingenuity to apply the Levy-Wiley C-22 developer to reduce development time and this we tried. Using this method will reduce the total time of processing to 13 minutes. The following is a resume of the times and solutions used.

TIME/TEMPERATURE AT 75°F

Levy-Wiley Developer	5½ minutes
2% Acetic Acid Stop Bath	1 minute
Wash	1 minute
Bleach/Fix	3 minutes
Wash	2 minutes
Stabilizer	30 seconds

ECOM RAC DEVELOPER

Water (tap)	700.0	ml
Benzyl Alcohol	5.0	ml
Sodium Sulfite (anhy)	2.0	grams
Sodium Hydroxide	16.0	grams*
Borax 5 H_2O	60.0	grams
OR		
Borax 10 H_2O	78.5	grams
Potassium Bromide	1.5	grams
Kodak CD-3	7.5	grams
Water to make	1.0	liter
pH: 11.5		

*DIGNAN: We used 15. grams of Sodium Hydroxide to arrive at a pH of 11.5 at 80°F.

ECOM RAC BLEACH/FIX

Water (tap)	750.0	ml
Ammonium Thiosulfate 60%	166.0	ml
Sodium Sulfite (anhy)	7.0	grams
E.D.T.A. Ferric Salt	100.0	grams
Water to make	1.0	liter
pH: 5.9		

STABILIZER

Formaldehyde 40%	20.0	ml
Wetting Agent	3.0	ml

EIGHTY-THREE DIFFERENT BRANDS OF COLOR NEGATIVE FILM AND HOW THEY SHOULD BE PROCESSED

There are perhaps five or six manufacturers of color negative films internationally, but there are over 83 different brand names. However ALL color negative film can be processed by using one of the three processing systems: Kodak C-41, Kodak C-22 and AGFA processing. The following list is current as of June 1975 and has been supplied by The Association of Photographic Laboratories of England.

Although there are only four films available for processing in C-41, at the present time many of the films listed under C-22 processing will either be discontinued or the film will be changed within a year or two, changed so that it is compatible with C-41 processing.

C-41 Processing

The following four materials are processed in Kodak C-41 solutions: Kodacolor II-35mm, 128, 110; Sakura Color II; Fujicolor II; Vericolor II S and L.

C-22 Processing

Brilliant, FK Color; Furicolor; GAF Color Print; Inter Color; Kranzcolor N21, N19; 3M Color Print; Negra Color; Oga Color; Prinz Color; Revue Color; Sakura Color; Sears Color; Tura Color; Cornet; Mr. Friendycolor; Valcolor; Twin Pix; David Jones Color; Color Neg Film ASA80; Clobal CN100; Shell; Ferrania Color Film; 3M NM64; Herbert Smalls Extracolor; AA Certified Color Print; Titan; Palcolor; Extra Spool; Milyerson; Paragon; Thrifty Color Neg; Focal; Porst Color; Teta Color; Ring Foto; Citcolor; Revue Colour 2000; Trifca Mk Vl (FCA) Fotop Colour; Color MN19 (FotoKemika Yugoslavia) Directacolor; Picture Pac Color Picture; Montgomery Ward Color Print ASA80; Berkeycolor Negative Film ASA80; Myercolor GN100; John Martins Color ASA80; Hanimex Vistacolor ASA100; Color Neg Film Cartridge/Kassette ASA64; Kodacolor X, Boots Color Print.

The following 110-format films are also processed by the Kodak C-22 process: Boots Color Print; Revue Color 2000; Pacific Prestige; Prinz Color; Trifca; GAF; AA.

Agfa Processing

The following films are compatible with Agfa processing: Agfa; CN17, CN14, CNS; Peru Color; Technicolor Print; International; Supercolor; Gevacolor; Gaytime; LGB; Nufilm; Pakocolor; Pacific Bonus; Modicolor; Famous Brand; Color 80; Vista Color; NUP; Western Union (Green); Color Service Terminal A; Pacific Prestige; Ring Foto; King Size USA; Boans Ultracolor; Hendry Francis; Rapid; LGP; Color Negative Film ACN; Agfa Color 110 Film, Fortecolor 17 DIN.

NOTES

Honeywell now distributes Agfacolor in the U.S. The film is sold with processing included. However many of the other brands listed are sold without processing. We do know that the Agfacolor negative formulas published in the AA issue, November 1970 should produce satisfactory results for all negative films listed above under Agfa processing.

It seems likely that most of the brands listed under C-22 processing will in the very near future be changed to a Vericolor type emulsion. Notice that Sakura Color II and Fujicolor II indicate Process C-41. Sakura Color without the prefix II is under C-22 Processing. Before you attempt the processing of any unfamilar emulsion, the above lists should be carefully checked as well as the cartridge, box and literature.

If in doubt, we would suggest C-22 processing, rather than C-41. Although C-22 may not produce perfect negatives at least you will be able to supply prints. If a film designed for C-22 processing or Agfa processing is run through C-41, there is a great possibility that the emulsion will leave the base.

SEMI OFFICIAL KODAK C-41 PROCESS

BY PATRICK D. DIGNAN

TIME/TEMPERATURE CHART

The following two steps to be done in total darkness:

Developer	3¼ min.	$100^{\circ}F \pm ¼^{\circ}F$
Bleach	6½ min.	$100^{\circ}F \pm 5^{\circ}F$

The remaining steps may be done in normal room light:

Wash (running water)*	3¼ min.	$100^{\circ}F \pm 5^{\circ}F$
Fixer	6½ min.	$75^{\circ}F$ - $105^{\circ}F$
Wash (running water)**	3¼ min.	$100^{\circ}F \pm 5^{\circ}F$
Stabilizer	1½ min.	$75^{\circ}F$ - $105^{\circ}F$
Dry	10 to 20 min.	$75^{\circ}F$ - $105^{\circ}F$

*Includes 10 second drain time in each step.

**Use fresh water changes throughout the wash cycles. Fill the processing tank as rapidly as possible from a running water supply for about 4 seconds. When full, agitate vigorously for about 2 seconds and drain for about 10 seconds. Repeat this full wash cycle. If desired, use a running water inflow-overflow wash with the cover removed from the tank.

C-41 COLOR DEVELOPER

Water (80 - 90°F)	800.0	ml
Potassium Carbonate (anhy)	37.5	grams
Sodium Sulfite	4.3	grams
Potassium Iodide	0.002	gram
Potassium Bromide	1.5	grams
Hydroxylamine Sulfate (HAS)	2.0	grams
Kodak Anti-Cal #3	2.5	grams
Kodak CD-4	4.8	grams
Water to make	1.0	liter

pH @ 80°F: $10.00 \pm .03$

The pH of $10.00 \pm .03$ is important. You may find that you have to vary the Potassium Carbonate from 25. to 35.5 grams. We used deionized water and eliminated the Anti-Cal #3. We also eliminated the Sodium Nitrate from the bleach.

BLEACH

Water	800.0	ml
Ammonium Bromide	150.0	grams
BL-1	175.0	ml
Glacial Acetic Acid	10.5	ml
Sodium Nitrate	39.0	grams
Water to make	1.0	liter

pH @ 80°F: $6.00 \pm .20$.

NOTE: In place of BL-1, you may use 80 grams E.D.T.A. Ferric Salt plus 15 grams Sodium Sulfite.

FIXER

Water	800.0	ml
Ammonium Thiosulfate 60%	162.0	ml
E.D.T.A. Na_2	1.25	grams
Sodium Bisulfite	12.4	grams
Sodium Hydroxide	2.4	grams
Water to make	1.0	liter

pH @ 80°F: 6.50 ± .20.

STABILIZER

Water	800.0	ml
Formalin 38%	5.0	ml
MX-812*	0.8	ml
Water to make	1.0	liter

*Special wetting agent made by Kodak. Substitute Photo-Flo.

FOR PROCESSING KODACOLOR II, VERICOLOR II, KODACOLOR 400, ETC.

We would like to point out that these emulsions are extremely hard. With the emulsions we have tested, it is difficult if not impossible to create reticulation. Dip tests of unprocessed Kodacolor II, 35mm in boiling water seem to affect the base more than the emulsion. The emulsion will leave the base after a few minutes if coaxed. However, if left on the base and dried, no reticulation took place. It appears that the very word reticulation may be a term that will have to be explained to the upcoming generations of new photographers. These new emulsions allow processing temperature tolerances unheard of in the past. Although the developer is plus or minus one quarter, the fixer has a temperature tolerance of 75°F to 105°F.

We have used the following substitute bleach/fix which replaces the bleach and fixer used. Use for 5 to 10 minutes @ 85 to 100°F with constant agitation:

BLEACH/FIX

Water	600.0	ml
Sodium Sulfite (anhy)	10.0	grams
Potassium Bisulfite	25.0	grams
E.D.T.A. Na_4	5.0	grams
E.D.T.A. Ferric Salt	25.0	grams
Potassium Iodide	1.0	gram
Ammonium Thiosulfate (60%)	200.0	ml
Water to make	1.0	liter

* * *

OFFICIAL FORMULAS FOR AGFACOLOR NEGATIVE FILMS CNS

Processing table

Baths	Code	Processing time in min.	Temperature in °C	Working capacity, films per litre	Useful life of fresh baths
1. Agfacolor Film Developer S	NPS I	8 [1])	20±0.2	6	6 weeks
2. Agfacolor Intermediate Bath [2])	NZW	4 [3])	20±0.5	6	6 weeks
3. Thorough wash	—	14	14—20	—	—
4. Agfacolor Bleaching Bath [4])	N II	6	20±0.5	6	3 months
5. Wash	—	6	14—20	—	—
6. Agfacolor Fixing Bath	N III	6	18—20	6	3 months
7. Final wash	—	10	14—20	—	—
8. Agepon Bath (1+200)	—	1	14—20	10	—

Notes:

[1]) The development time may be varied between 7 and 9 minutes, depending on the result of sensitometric tests.

[2]) To achieve uniform results 30 ml Film Developer S must be added to each litre of Agfacolor Intermediate Bath.

[3]) If necessary the time given in the intermediate bath may be varied between 3 and 5 minutes for adjustment to the number of cycles and cycle time of frame type processing machines.

[4]) As the masks form in the bleaching bath care should be taken to see that the processing time and temperature of the original bleaching bath are maintained exactly (at 20° C±0.5).

Only original Agfacolor processing baths should be used for development and replenishment of this film.

FILM DEVELOPER S (NPSI)	WORKING SOLUTION
Calgon (photo grade)	4.0 grams
TSS Developing Agent (see Note No. 1)	2.75 ± 0.3 grams
S-55 (Hydroxylamine Sulfate)	1.20 ± 0.12 grams
Sodium Sulfite	2.0 ± 0.2 grams
Potassium Carbonate	75.0 ± 7.5 grams
Sodium Hydroxide	None
Potassium Bromide	2.50 ± .25 grams
Water to make	1.0 liter
pH 10.85 ± .05 (68°F)	

NOTES

Note No. 1. TSS Developing Agent. This is Agfa's code name for N-Diethyl-p-Phenylene Diamine Sulfate. You can substitute Kodak's CD-1 N,N-Diethyl-p-Phenylene Diamine Monohydrochloride. However, with this substitution use 3.43 grams. pH correction may be necessary.

INTERMEDIATE N2W (see note 2)

Sodium Sulfate	45.0 grams
Potassium Bromide	0.25 ± .05 grams
Plus Developer S (NPSI)	30. ml per liter
Water to make	1.0 liter

pH 10.35 ± .10 (68°F)

Note No. 2. IMPORTANT. This bath is extremely important in producing satisfactory results. In the above processing table, special attention should be paid to Note 3 which states that "to achieve uniform results, 30 ml film developer S must be added to each liter of Agfa color imtermediate bath. The pH of 10.35 is produced from adding the developer.

After testing out this official formula, we produced superior results utilizing the following formula (used as a one-shot):

SUBSTITUTE INTERMEDIATE BATH

Magnesium Sulfate (epson salt)	31.0 grams

To this bath should be added 30 ml of film developer S. Note that the bromide has been deleted from our substitute formula.

AGFACOLOR BLEACH (N11)

Calgon	7.0 grams
Potassium Ferricyanide	42.0 grams
Potassium Bromide	12.0 grams
Potassium Phosphate, Mono	15.0 grams
Potassium Dibasic Phosphate	5.0 grams
Acetic Acid Glacial 96%	None
Water to make	1.0 liter

pH 5.95 ± .10 (68°F)

AGFACOLOR FIXER N111 (see note 3)

Sodium Thiosulfite ($10_H 20$)	200.0 grams
Sodium Sulfite (anhy)	5.0 grams
Potassium Metabisulfite	0.5 gram
Water to make	1.0 liter

pH 7.30 ± .20 (68°F)

Note No. 3. If you use Sodium Thiosulfite, anhy, use 128. grams for the working solution and 160. grams for the replenisher. Sodium Bisulfite may be substituted for Potassium Metabisulfite. Use to adjust pH 7.3.

NEW SUBSTITUTE FORMULAS FOR EASTMAN #5247 •

#5247 HAS BEEN CHANGED

THE SCN-2 BLEACH HAS ALSO BEEN CHANGED TO SR-29 by Rex. A. Ackley.

ED NOTE: Perhaps you will remember Mr. Ackley from past issues of the Newsletter. When Eastman Color #5247 was first placed on the market, Mr. Ackley processed dozens of cassettes and attempted to compound a color developer that would do the following:

1. Use the film in daylight without an 85A filter.
2. Produce good definition.
3. Reduce the high contrast.
4. Develop at 75°F for better control.

He was **unsuccessful.** He recently purchased two hundred feet of the newest emulsion and makes the following report.

When I purchased the film, the salesman warned me that if I had been using #5247 before, I would find this film changed. Sure enough there is a caution label on the front of the film can about using a new bleach called SR-29.

KODAK SR-29 BLEACH		Replenisher
Water (90°F - 100°F)	900.0 ml.	900.0 ml
Potassium Ferricyanide	40.0 grams.	55.0 grams
Sodium Bromide (anhy)	25.0 grams.	35.0 grams
Water to make	1.0 liter.	1.0 liter

pH 6.5 at 80°F.

However, tests show that almost any bleach will work for the small user.

The new film **is** different. I developed a roll of the new and the old simultaneously and there is a big difference.

Then I experimented with the simplest color formula possible and lo and behold, almost perfect prints the first shot. Since then I have found out the film is not really a 3200K film, it is closer to 4500K. Then, I found out why sodium bicarbonate is used in the SCN-2 formula; to drop the Kelvin. It works opposite of 6NBN (Anti-Fog 2) which raises the color temperature. (For SCN-2 official formulas, see April 1974 Newsletter).

Kodak seems to have changed the film in the following manner: Improved response to flesh tones, cut the contrast, and apparently attenuated its response to UV. At least my first 12 cassettes show this. I am getting excellent results. It is noticeably better in definition and color purity, than 5254.

The new film can be identified by the caution on the box and film can. Also, 5254 used to have an 'E' prefix in the footage legend along the side of the film. The old 5247 had an 'H' prefix and the new is an 'F'. The following simple formula will print on the cool side, quite a bit less yellow filter than Kodacolor II. I do not like Kodacolor II because of that, it makes normal blues too dark. This film developed as I do, prints about -10Y -05M from the Kodak recommended pack for 37RC.

DEVELOPMENT SCHEDULE AT 75°F + ½°F

Develop	14 Minutes
Rinse	(two quick fills and dumps)
Short Stop	
Remove Jet Backing	
Wash	2 Minutes
Bleach	6 Minutes
Wash	4 Minutes
Fix	6 - 8 Minutes
Wash	5 Minutes

Expose 5247 without 85A filter on camera.

DEVELOPER (One Shot)

A

Water (de-ionized)	350.0 ml
Sodium Sulfite	1.28 grams
Potassium Bromide	.5 gram
Sodium Carbonate (mono)	12.5 grams

B

Water (de-ionized)	100.0 ml
CD-3	2.0 grams
pH 10.25	10.25

Immediately add 'B' to 'A', add de-ionized water to make a total of 500 ml. Age one hour, but do not use after 12 hours. Loses activity after that time.

For one roll, use a double 35mm tank, with a dummy reel on top. Use only 250 ml developer.

Agitation: Vigorous agitation must be avoided or overall density and contrast will increase to an unwanted level. Best method, seems to be to lift the tank from the water bath, invert and continue through 360 degrees, then set tank back in water bath. Do this once each 30 seconds. This will assure each point of the negative getting different developer and will prevent hot spots and streaks.

SHORT STOP

Water	450.0 ml
Sodium Bisulfite	2.5 grams
Add water to	500.0 ml
pH 4.5	

BLEACH

Water	400.0 ml
Copper Sulfate	25.0 grams
Ammonium Chloride	25.0 grams
When mixed, add water to	500.0 ml
pH 3.0	

As mentioned the official Kodak Bleach formula is now SR-29. However, the above copper bleach works as well if not better. It has a long life if not used promptly (one year at least), will process 6 cassettes of film before exhausting, or on a replenishment schedule of 2 ml per frame lasts indefinitely.

NOTE: You may buy copper sulfate at a hobby store in one of those little 50¢ bottles if you cannot find it otherwise and wish to try this bleach. It can be purchased at better garden supply shops under the name "Mountain Bluestone" for about $1.35 per lb.

I tried the usual potassium ferricyanide and also potassium bichromate bleaches and they work as well. I also used a blix, based on the blix in the Newsletter many times for type 'B' paper. This requires 10-12 minutes.

This may not completely remove the silver. I did not test sufficiently to be sure. Almost any fixer will work, just make certain that the pH is not lower than 6.3. Kodak says that pH will deteriorate the dyes.

ANTI-HALATION LAYERS

Photographers very seldom really look at their film before they expose it, especially if they use roll stock. A few weeks ago we received a phone call from a lab that was trying their first roll of #5247. "We have just used your NCF-41 to process a roll of #5247 and the emulsion is coming off!" As it turned out, it was not the emulsion, but the anti-halation backing, so let's discuss it.

There are two methods used by film manufacturers to incorporate anti-halation layers in color film. Most camera emulsions used for still photography, which include negative or reversal, use a very thin layer of predeveloped silver (black) next to the base. If you will examine the tongue of a roll of unprocessed film you will notice that the dull emulsion side is a cream color. The back side (shiny side) appears black. If you process your own film, you may also have noted that the black does not disappear until after you have either bleached or bleach/fixed. In fact, you can use this as a means to tell the speed of bleaching. If you double this bleaching time, you can be reasonably certain the solution has done its job.

REM-JET LAYER

There is a second type of anti-halation layer used for motion picture film, both negative and positive. It is called a Rem-jet anti-halation layer. This is a layer that is placed on the BACK OF THE FILM BASE. It is composed of a resin and finely dispersed carbon black. It really serves three purposes in motion picture use. It helps prevent static electricity, helps prevent scratches and also acts as the anti-halation layer.

In large processing installations, this Rem-Jet layer is removed by using an alkaline solution for about 10 seconds and then a quick spray wash aided by a rotating brush. If you have a roll of #5247, examine the tongue; wet your finger with a little soapy water and rub the black, back of the film; the Rem-Jet is readily removed. When using this film for still photography, it is important to remove this backing completely before the film is dried. Any particles left on the emulsion side will not only produce white spots on your prints, but will become inbedded in the emulsion . . . which will make all your work . . . for naught!

DO-IT-YOURSELF MACHINE FOR

REMOVING JET BACKING FROM E.K. 5247 AND 5385 35MM FILM

BY VINCENT THOMAS

The idea for the following described equipment to facilitate the removal of the jet backing from EK #5254 and #5385 film was derived from the reel setup used to wind and rewind movie film. It is essentially the same except it is minus the gear drive. No dimensions are given in the drawings as it is the authors thinking that each "do it yourselfer" will adapt the basic idea to his own particular requirements. Construction can be of wood or plastic. If wood is used, be sure to give all parts a good coating of water resistant paint, as the machine is used in the sink, and is thoroughly drenched with water when in operation.

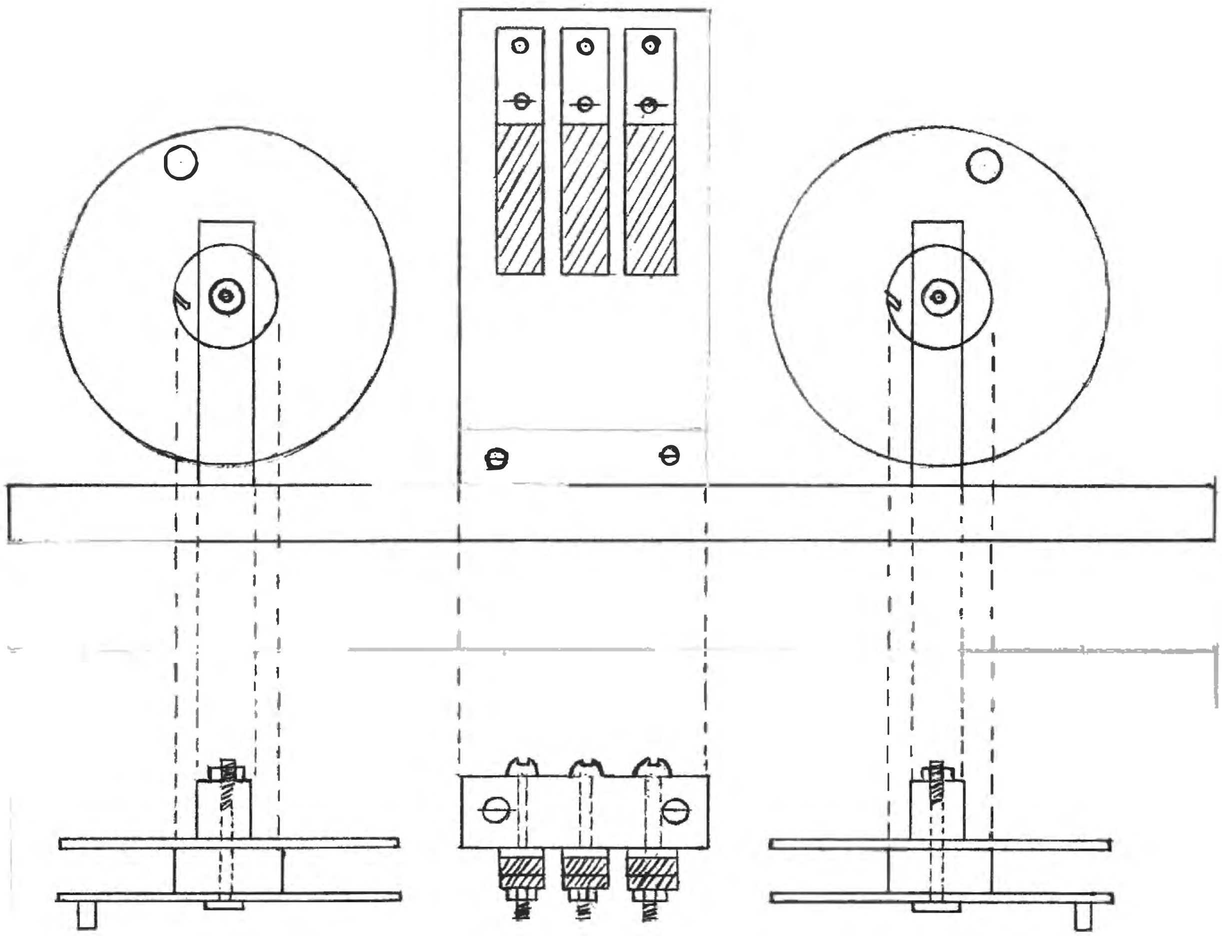
Construction is quite simple and no special tools are required. First you will need two tenite or plastic bulk film cores. These cores usually have a one inch diameter core hole. Plug the hole with a tight fitting dowel. Drill a 1/4" hole through the axis of each plug using a 1/4" body drill. Next, depending on how much film is involved, make four side plates of sufficient diameter to contain the required amount of film. Use a fly cutter if you have one, if not, cut the plates square and round off the corners. Using either glue, plastic cement or brass flat head screws, fasten one side plate to each film core. Again run the 1/4" body drill through the core and the side plate. Prepare the remaining two side plates as follows. Two pieces of 1/2" x 3" plastic or wood dowel rod are needed for turning handles, which are fastened fairly close to the outside edge of the each side plate. Fasten the side plates to the cores and once more, run the 1/4" drill through the completed assembly.

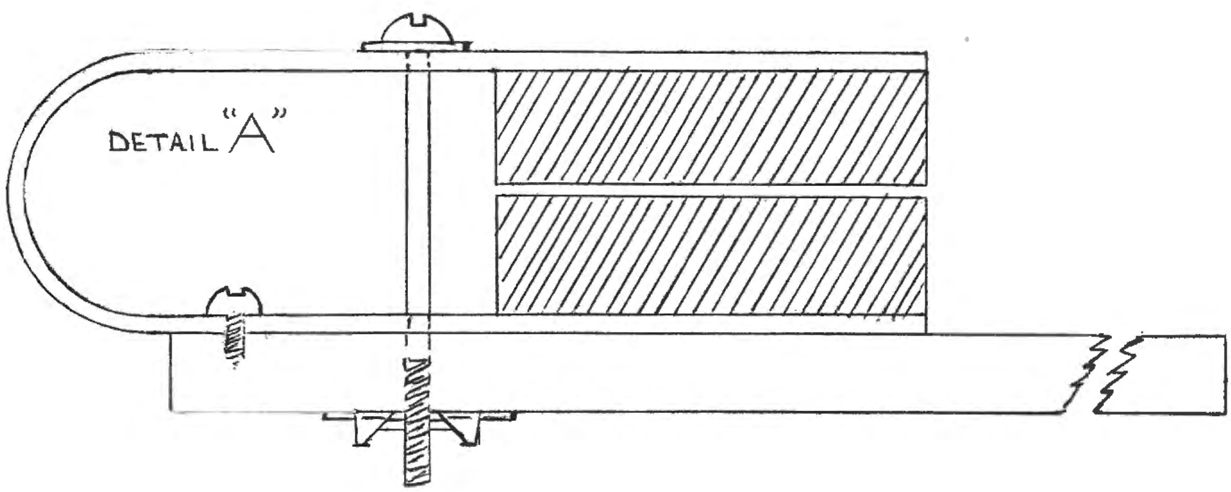
You now have two reels either of which can be used for loading the film or takeup. Make a base wide enough to prevent the unit from tipping over and long enough to provide at least 8" to 10" clearance between the outside diameter of the reels. Two reel support posts are next, and they should be of sufficient height to provide clearance between the reels and the base.

The support posts should be fairly sturdy, not less than 1" square, 2" would be better. Drill a 1/4" hole through each post about 1" from the end and fasten them to the base. Next you will need two 1/4 x 20 thread cadmium plated bolts, to be used as shafts for the reels. (Sears Department stores have a good selection of these bolts, nuts, washers, etc.) plus six 1/4" washers, and four 1/2 x 20 nuts. Assemble the reels to the support post thusly. Put one washer on the bolt, reel next, then a washer. If there is enough thread on the bolt to clear both sides of the post, run a nut on, then a washer. Insert the bolt through the post, then a washer, and lock it up with the last nut. Be sure the reel turns free on the shaft. So much for the load and takeup assembly.

The mounting of the SQUEEGEE sponges is also quite simple. From your local photo supply store get three YANKEE type Squeegee sponges or the equivalent of same. These squeegees come with either plastic or stainless steel "U" frames. Using either plastic or wood, make a mounting block of sufficient size to allow at least one inch space between each squeegee. The squeegees must be fastened to the mount in a vertical position. See Detail "A", that shows how to attach the squeegee to the mount and also the sponge tension adjustment, which is simply a 1/4 x 20 cadmium plated bolt with a wing nut. Mount the squeegee holder on the base so that the center line from the reel cores passes through the opening between the squeegee faces. A piece of string fastened to the reel cores will serve as a guide. Last but not least, your dime store can supply you with a kitchen gadget called "Swing and Spray" that fits over the sink faucet. A lever on the device controls the flow of water from a full stream to a spray. The spray is what you will use...To use the jet cleaner, proceed as follows. After the film has gone through the first wash, wind it on to one of the cleaner reels, starting the film at the UNDERSIDE of the cores. This will place the jet backing on the outside and face up when it is fed on to the takeup reel. After the loading is completed, wash off about two feet of film, and thread it through the squeegee sponges and on to the takeup reel. Turn on the spray and wind the film through the unit at a speed that allows complete removal of the jet backing. The first squeegee should remove at least 70% and the other two finish the job. If you want to make doubly sure, just rewind it. Rewinding the film back on to the processing reel should present no problem, as you most likely use a film loading device of some design.

Try it, you'll like it!!!!




DETAIL "A"

NEW SUBSTITUTE FORMULAS FOR C-22 IN 12 MINUTES FOR PROCESSING KODACOLOR X, FUJICOLOR AND 3M COLOR PRINT FILM

Although Kodak is rapidly switching over to the C-41 chemical process, C-22 is by no means dead and it will probably be a couple of years before this old stand-by is discontinued completely. There is still a lot of CPS, Kodacolor X and negative films manufactured by other firms. As an example, Fuji of Japan still recommends the C-22 process for their line of Fujicolor and ditto for 3M. The newer Sakura Color N100 distributed in the United States by Berkey Photo also utilizes the C-22 process.

Mr. V.K. Sekhri in the B.J.P., January 10, 1975 used the Levy-Wiley short C-22 process as a starting point for compounding a new developer and bleach/fix which produces a lower normal contrast than the Levy-Wiley formulas. Using the Kodak monitoring system Manual Z-115 and Kodak control strips, the new formulas produce negatives within the processing tolerances for fog, speed and contrast as explained in this manual which is available from Eastman Kodak for $10.00.

PROCESSING SCHEDULE	Time	Temp.
Developer	5½ minutes ± 5 sec.	75° to 74½°F
Bleach/fix	3½ to 4½ minutes	75° to 73°F
Wash (running water)	2 minutes	" "
Photo Flo	1 minute	" "
Dry		130°F

The primary improvements claimed by Mr. Sekhri is the adding of hydroxylamine sulfate to the developer and lowering the pH of the Levy-Wiley formulas from 11.5 to a pH of 11.4 ± 0.10. The improvements in the bleach/fix consisted of adding potassium thiocyanate. The addition of thiocyanate to a bleach/fix as a fixing accelerator is certainly nothing new. The formula of A.H. Gordon that was proposed in 1956 also used thiocyanate. This formula appeared in the March 1974 Newsletter. The only problem with this chemical is that it can cause reticulation, if the emulsion is soft either due to the method of manufacturing or using processing solutions at a higher than recommended temperature.

AGITATION

Reducing the time of any developer severely increases the requirements for precise agitation and timing. This is true with the Levy-Wiley formulas, C-41 and the formulas to follow. These requirements are clearly spelled out by Kodak in the instructions accompanying their C-41 chemistry. Mr. Sekhri recommends the following procedure:

Film was processed in developer for 5½ minutes at 75°F with agitation for 2 sec every 10 sec for the first 1½ minutes and then for 3 sec every 15 sec. After 5 min 20 sec the developer was poured out and on the stroke of 5 min 30 sec, bleach/fix was introduced into the tank. Bleaching and fixation continued for 3½ min at 75°F with agitation for 3 sec every 20 sec. The film was then washed with running water for 2 min and immersed in the final rinse (photo-flo) for 1 min and dried at 130°F.

DEVELOPER

Water	700.0	ml
Benzyl Alcohol	5.0	ml
Calgon	2.0	grams
Potassium Bromide	1.5	grams
Hydroxylamine Sulfate	2.0	grams
Potassium Iodide	0.020	gram
Sodium Hydroxide	16.25	grams
Borax ($10H_2O$)	60.0	grams
plus	solution A*	
water to	1.0	liter

*SOLUTION A

Water	100.0	ml
Sodium Sulfite	2.5	grams
CD-3 (DD-3)	7.5	grams

BLEACH/FIX

Water	700.0	ml
Ammonium Thiosulfate (60%)	165.0	ml
Sodium Sulfite (anhy)	7.0	grams
EDTA, Ferric Salt	100.0	grams
Potassium Thiocyanate	5.0	grams
Water to make	1.0	liter
pH at 75°F	6.0 ± 0.2	

The original publication of this Bleach/Fix contained a serious typographical error. The formula contained ammonium thiosulfate and also stipulated sodium thiosulfate. We are certain that it should have read sodium sulfite. We have made the appropriate correction.

E-6 PROCESSING CHANGES THAT CHANGE COLOR BALANCE

Expose a 20 exposure roll of one of the E-6 Ektachromes to a color chart and gray scale. Do not bracket your exposure. When starting to experiment with color balance changes, the best system is to use the E-6 kit First Developer. After developing and washing, insert a 2% Acetic Acid stop bath for 1 minute and then another 2 minute wash. At this point, dry and re-expose the film. This roll should then be cut into individual frames for testing.

COLOR DEVELOPER CHANGES: (See formula, page 59). Lacking a pH meter, the simplest method is to decrease the final amount of the alkali (Sodium Phosphate Tribasic) about 25% and leave out the Sodium Hydroxide. Make a test and then increase the amount of alkali about 5% at a time, making single tests after each addition. When you reach 40 grams of Sodium Phosphate Tribasic, the amount called for in the formula, make another test and then add the 3 grams of Sodium Hydroxide. Test again. This should give you the correct pH of 11.1 However, you can and should test the effect of increasing the pH by adding either more Sodium Phosphate Tribasic or Sodium Hydroxide.

As a general rule, low pH of the color developer produces a blue-magenta color balance. High pH produces a yellow-green color balance. Tape each frame to a sheet of paper with the notes concerning each test so that the results can be duplicated.

CHANGES TO MAKE IN FIRST DEVELOPER: To increase yellow-magenta, increase the amount of Potassium Iodide and Potassium Bromide about 25%. Also, increase processing time 20 seconds or increase the temperature 2°F.

To Decrease Yellow: Increasing the amount of Thiocyanate 1/10th of gram will produce a very noticeable change.

To Increase Yellow: Decrease Thiocyanate 1/10th of a gram.

CONTRAST CHANGES: First developers for color reversal usually use an Elon/Metol (Phenidone) Hydroquinone ratio of 1:2. To lower contrast, use 2:1. For medium contrast, use 1:1.

For more information on how to test reversal film, see "Experimenting with the E-6 Kit at 75°F" on page 58.

EXPERIMENTING WITH THE E-6 KIT AT 75°F

Using a Unicolor Film Drum with the Unicolor Agitator, we used the E-6 kit first developer at 75°F to see if the 100°F was essential to the process. It was not.

Here is the method that we used to test first development:

pH worries alot of darkroom workers, especially those doing reversal processing. We are going to show you how to determine your processing time without worrying about pH either with the Kodak kit or a substitute formula.

For this system to work it is important that once you decide to use a first developer, you use or compound it the same way each time. In other words, do not start making small changes unless you wish to change the results, such as the contrast, color balance, etc. Also use the same amount of solution each time and use it as a one-shot. The one disadvantage of lowering the temperature of the E-6 process, is the long processing time, IF INTERMITTEN AGITATION is used. IF CONTINUOUS AGITATION is used, it is simply a matter of setting your timer and doing other things while you are waiting.

The first thing to do is shoot a roll of color patches and gray scale. We now use the Macbeth ColorChecker. We would also suggest exposing this test roll using daylight. We have seen hundreds of strobe lit gray scales sent to us in the last few years, and it is difficultto get even light, without flare, unless you use double strobes or an umbrella. Bounce strobe will probably give you a color cast. It is a good idea to surround your chart with black cloth, just to make certain you are not picking up stray reflections from colored objects. This test roll should be exposed at the recommended ASA, do not bracket.

The developer, tank and reel should be at room temperature. Let us assume that this is 75°F. Again, what ever the temperature, try to carry out the following series of experiments at the same temperature.

We used the E-6 kit first developer. Using one pint to two reels (one reel contained the test film, the other empty) in the Unicolor Film Drum. We did not know how long this type of development should be, but we assumed between 10 and 20 minutes.

We develop for 10 minutes. Pouring out the developer and pouring in a 2% acetic acid stop bath. After 1 minute of agitation, we poured out the stop bath (discarded) and then washed for about **5 minutes.** We drained the drum and then in complete darkness, opened the drum and removed a few frames, **still in darkness, we closed the drum.** The strip that was removed was run through the balance of the E-6 chemistry in room light at approximately 100°F. It should be emphasized that we stopped development with the stop bath and then washed the film to remove the stop bath.

After viewing the results of the strip we had removed, processed and dried, we judged whether or not first development was sufficient.

Now, we could have started with 6 or 7 minutes, but at 75°F rather than 100°F, it seemed pointless. This first test strip was dark, although a gray scale could be seen. We developed the second strip another five minutes, again, stopping development with 2% acetic acid and washing. We then removed the second strip in total darkness, closed the drum and processed this second strip throughout the process. This was repeated a third time with the remaining strip for another 5 minutes. This gave us a series of three first developments from the same roll, for 10, 15, and 20 minutes. We could have changed this to 1 minute intervals and extended the test.

We decided that about 15 minutes produced the best results with the emulsion and kit we used.

IS THE REVERSAL SOLUTION NECESSARY?

No. As long as you give full light reversal, this solution can be dispensed with.

The patent literature on reversal processing always point up that chemical reversal produces improved results over light reversal. We do not find this statement true, at least with the E-6 Ektachromes for the small user, processing only a few rolls at a time.

Using the suggested experimental roll, the reader can easily prove to his or her own satisfaction, whether or not this extra solution is necessary.

If, after removing 3 or 4 frames per test as recommended, a check on using the reversal bath can be proven by simply removing one frame and placing this in the reversal bath. The remaining frames can be light exposed (photo-flood, ½ minute per side).

Light re-exposure is another item that can be easily investigated. We have used fluorescent, daylight and tungsten for re-exposure before color development, all with excellent results. Claims about over-exposure (during re-exposure) do not bare out experimental evidence. However, it is possible to under-expose before color development.

TIME & TEMPERATURE OF E-6 COLOR DEVELOPER

Just how important are the Kodak time and temperature recommendations for the color developer? We have not attempted over development at 100°F, but we have at room temperature (68°F - 75°F). In fact, we left a few frames in the E-6 color developer for **24 hours without agitation.** NO ADVERSE AFFECTS WERE NOTED.

Last year, in the Dignan Newsletter, Richard Bisbey recommended ALMOST ANY FIRST DEVELOPER, E-3, E-4, etc. He also recommended Agfa CT-18 for about 23 minutes at 75°F with constant agitation. That formula is as follows:

FIRST DEVELOPER AGFA CT-18 MODIFIED BY BISBEY

Water	800.0 ml
Metol	2.0 grams
Sodium Sulfite	25.0 grams
Hydroquinone	4.0 grams
Sodium Carbonate (mono)	30.0 grams
Potassium Thiocyanate	2.0 grams
Potassium Bromide	2.0 grams
Benzotriazole (0.2% solution)*	15.0 ml
Potassium Iodide (.1% solution)**	10.0 ml
Water to make	1.0 liter

*To make 0.2% solution, add 2.0 grams to 1000 ml of water (125°F).

**To make a .1% stock solution of potassium iodide, add 1.0 gram to 1000 ml of water.

The following color developer modified by Bisbey was Ernest Gehret's substitute E-3 color developer. This appeared in the May, 1969 Newsletter and also in the "British Journal of Photography", January 1, 1960.

GEHRET'S COLOR DEVELOPER MODIFIED BY BISBEY

Distilled water	700.0 ml
Sodium Phosphate, tribasic	40.0 grams
Sodium Hydroxide	3.0 grams
Sodium Sulfite (anhy)	2.0 grams
Citrazinic Acid	0.5 to 1.0 gram
Ethylenediamine Sulfate	8.0 grams
Kodak CD-3	10.5 grams
Water to make	1.0 liter

pH: 11.1

Important note: The above formula should be used with all E-6 Ektachromes, except Ektachrome 200. Increase pH with sodium hydroxide to pH 11.5 at 75°F.

The following is a summary of a schedule used for 75°F processing:

STEP	TIME IN MINUTES @ 75°F
First developer	23
Stop	2
Wash	3
Re-exposure	½ per side
Color developer	21
Stop	2
Wash	4
Bleach/Fix	5
Wash	7
Stabilizer	1

The bleach/fix was made from the following two stock solutions:

Part A

Potassium Ferricyanide	80.0 grams
Potassium Bromide	18.0 grams
Water to make	500.0 ml

Part B

Sodium Thiosulfate (penta)	200.0 grams
Water to make	500.0 ml

Mixed in equal parts 15 seconds before use. (Separate bleach and fix steps also work, e.g., 8 minutes bleach, 1 minute wash, and 6 minute fix.) Finally, the stabilizer was 5 ml of 37% formaldehyde in 1 liter water (with a few drops of wetting agent).

What does all of this add up to? You can use other chemistry, you can mix it yourself, and most important, you can produce results that, in many cases surpass machine processing. All, without using alot of hot water and the energy necessary to heat it!

HOW TO DEVELOP COLOR PRINTS IN ROOM LIGHT

BY PATRICK D. DIGNAN

We recently tried the novel approach to processing a color print. We did it in room light. First, a resume of the procedure and then complete instructions.

Make an exposure using a color negative and filter pack that you know produces a normal print. You process this print not in your color developer, but in diluted D-72, you then fix in plain hypo. This procedure will yield a black and white print. The rest of the operation can be conducted in room light. After washing, the print is bleached in a ferricyanide/bromide bleach. Most of the image disappears in this solution. It is then washed. The print may then be dried and stored for future use or it may be color developed. The rest of the color processing steps should then be followed and will yield a normal color print.

At this point, you may ask, why bother. Besides the fact that it may surprise your friends, it is another way to check color processing as to the particular system you are using. You may be doing something in the dark that you are not aware of, because you cannot see it. Using this method, you can see the color slowly appear.

For the teacher, it is an exciting way to show the student that a color emulsion REALLY contains the light sensitive silver halide, just like black and white emulsions. The developed metallic silver of the image is converted back to silver halide in the ferricyanide/bromide solution. To see how the bromide speeds bleaching, you can put the print in a solution of ferricyanide which bleaches very slowly. If you now mix in a solution of bromide, you can note the acceleration of bleaching caused by this combination.

After bleaching and washing, the color developer redevelops the silver halide, the oxidation that takes place reacts with the couplers to form the dyes of the final image.

You can also see the difference between the color before the silver is bleached and after it is bleached. In some pictures you may prefer to leave the silver in. Different effects can be created by bleaching only part of the image, which can be done with a brush or piece of cotton.

One other use occurs to us. It would be a great way to make titles for a motion picture that has to do with photography. Medium wide angle of darkroom showing the operator making the print in the enlarger. He then takes the paper and places it in the developer. The camera moves in to a full frame of the piece of paper where the picture comes to full color. This would be difficult to do optically.

So, for the reasons mentioned, and any others that you can think of, here is the detailed procedure.

TIME TABLE @ 75°F

Developer (mod. D-72)	1 minute
Fixer	3 minutes

Room lights on

Wash	5 minutes
Bleach (until only faint image is visible)	
Wash	5 minutes

Color developer and remianing color processing steps.

BLACK & WHITE DEVELOPER (modified D-72)

Water	700.0	ml
Metol or Elon	2.0	grams
Sodium Sulfite	25.0	grams
Hydroquinone	6.0	grams
Sodium Carbonate (mono)	40.0	grams
Water to make	1.0	liter

Dilute 1:1 for use.

FIXER

Almost any black & white or color fixer can be used. If you just want to run a couple of test sheets, the following can be used.

Sodium Thiosulfate (anhy)	150.0	grams
Water to make	1.0	liter

BLEACH

Potassium Ferricyanide	25.0	grams
Potassium Bromide	7.0	grams
Water to make	1.0	liter

* * *

MODIFIED E-4 EKTACHROME PROCESS

BY DAVID MURRAY

The following process enables an individual to prepare E-4 processing solutions without the difficult to obtain chemicals and to take advantage of the faster high temperature process. The reversal agent, tert-butylamine borane, was excluded from the Color Developer because of difficulty obtaining this compound and because of possible patent violations.

These solutions are for processing Kodak's EF, EX, EH and #7242.

PROCEDURE

STEP	SOLUTION	TIME
1.	Prehardener	3 min.
2.	Neutralizer	1 min.
3.	First Developer	6 min.
4.	Stop Bath 1	2 min.
5.	Wash (room light)	4 min.
	Reversal exposure - 15 seconds, each side with #2 photo-flood.	
6.	Color Developer	9 min.
7.	Rinse	½ min.
8.	Stop Bath 2	2-3 min.
9.	Wash	3 min.
10.	Bleach	3 min.
11.	Rinse (running water)	1 min.
12.	Fix	2 min.
13.	Wash	6 min.
14.	Stabilizer	1 min.
15.	Dry	

TOTAL: 44 minutes.

NOTES: Do not skimp on the wash times, since they are the very minimum.

TEMPERATURE: The temperature of the prehardener and first developer should be maintained at $85^{\circ}F \pm \frac{1}{2}^{\circ}F$. The other solutions and washes can be used at $82^{\circ}F$ to $87^{\circ}F$.

AGITATION: Continuous for the first 15 seconds then 5 seconds every 30 seconds. The First Developer should be agitated continuously for the first 2 minutes and then 10 seconds every 30 seconds.

Since the processing times given for the bleach and fixer are the very minimum, concentrated solutions which must be diluted for use and discarded afterwards are used. It may be desirable to make concentrated solutions for some of the other steps.

PREHARDENER

Water	800.0	ml
Sodium Sulfate	140.0	grams
Formaldehyde 40%	30.0	ml
Potassium Bromide	16.0	grams
Water to make	1.0	liter

NEUTRAZILER

Water	800.0	ml
Hydroxylamine Sulfate	18.0	grams
Potassium Bromide	20.0	grams
Sodium Acetate	7.0	grams
Acetic Acid Glacial	7.0	grams
Sodium Sulfate	50.0	grams
Water to make	1.0	liter

FIRST DEVELOPER

Water	800.0	ml
Calgon	2.0	grams
Phenidone	0.35	gram
Sodium Sulfite (anhy)	50.0	grams
Sodium Carbonate (mono)	35.0	grams
Hydroquinone	6.0	grams
Potassium Bromide	2.0	grams
Sodium Thiocyanate	1.3	grams ± .1 gram
Sodium Hydroxide (to balance pH)	2.0	grams ± .5 gram
Potassium Iodide (.1% solution)*	6.0	ml
Water to make	1.0	liter

pH: 9.9 to 10.1 @ 80°F.

*To make .1% solution, add .100 (100. mg) to 100. ml water or 1. gram to 1. liter (1000 ml).

FIRST & SECOND STOP BATH

Water	800.0	ml
Potassium Alum	20.0	grams
Sodium Sulfate (anhy)	20.0	grams
Sodium Acetate	15.0	grams
Acetic Acid Glacial	15.0	grams
Water to make	1.0	liter

pH: 10.9 to 11.0.

Make a double batch of this solution and use one after the first developer and the second after the color developer. After use, do not interchange these solutions.

MODIFIED E-4 (Continued)

COLOR DEVELOPER

Water	800.0	ml
Sodium Phosphate Tribasic	40.0	grams
Sodium Hydroxide (to balance pH)*	8.0	grams
Ethylenediamine Sulfate	7.6	grams
Benzyl Alcohol(35% solution)**	10.0	ml
Citrazinic Acid	1.3	grams
E.D.T.A. Na_4	3.0	grams
Sodium Sulfite	5.0	grams
Potassium Bromide	0.2	gram
Potassium Iodide (.1% solution)	10.0	ml
ADD BEFORE USE:		
Kodak CD-3 (in 50. ml water)	12.0	gram
Water to make	1.0	liter

pH: 11.8 to 12.0.

*Balance pH refers to changing the amount of alkali to adjust for pH.

**BENZYL ALCOHOL 35%

Benzyl Alcohol	35.0	ml
Diethylene Glycol	45.0	ml
Water	20.0	ml

BLEACH STOCK SOLUTION

Concentrate: Dilute 1:4 (bleach 1 part/water 3 parts) use once and discard.

Water	800.0	ml
Potassium Ferricyanide	300.0	grams
Potassium Bromide	75.0	grams
Disodium Phosphate ($7H_2O$)	45.0	grams
Monosodium Phosphate (anhy)	12.0	grams
Sodium Thiocyanate	25.0	grams
Water to make	1.0	liter

MODIFIED E-4 (Continued)

FIXER STOCK SOLUTION

Concentrate: Dilute 1:5 (fixer 1 part/water 4 parts) use once and discard.

Ammonium Thiosulfate (60% Solution)	1.0	liter
Potassium Bisulfite	100.0	grams

STABILIZER

Water	800.0	ml
Formaldehyde, 40%	3.0	ml
Photo-Flo	10.0	ml
Water to make	1.0	liter

* * *

FORMULAS FOR PROCESSING E-3 EKTACHROME

STEPS, TIME AND TEMPERATURE	MINUTES	
Black & White Developer	10	75°F ± ¼°F
Rinse	½ - 1	68°F to 79°F
Hardener Stop Bath	3 - 10	"
Wash	3	"
Reversal (#2 flood)	½	"
Color Developer	15	"
Washing	5	"
Clearing	5	"
Rinse (in running water)	5	"
Bleach	8	"
Rinse	1	"
Fixing	4	"
Wash	8	"
Stabilizer	1	"
Dry		

TOTAL TIME: 65 to 72 minutes

FIRST DEVELOPER

Water	700.0	ml
Elon or Metol	2.0	grams
Sodium Sulfite (anhy)	25.0	grams
Hydroquinone	4.0	grams
Benzotriazole 0.2% solution	15.0	ml
Sodium Bromide	1.72	grams
Sodium Carbonate (mono)	30.0	grams
Sodium Thiocyanate	2.0	grams
Water to make	1.0	liter

HARDENER

Water	800.0	ml
Potassium Chrome Alum	30.0	grams
Water to make	1.0	liter

COLOR DEVELOPER (FOR E-3 ONLY)

Water	700.0	ml
Benzyl Alcohol	5.0	ml
Calgon	2.0	grams
Sodium Phosphate Tribasic	40.0	grams
Sodium Hydroxide	5.6	grams
Sodium Sulfite (anhy)	2.0	grams
Potassium Iodide 0.1% solution	10.0	ml
Citrazinic Acid	0.65	gram
Ethylenediamine Sulfate	7.8	grams
Kodak CD-3	10.5	grams
Water to make	1.0	liter

CLEARING BATH

Water	800.0	ml
Sodium Bisulfite	20.0	grams
Hydroquinone	1.0	gram
Water to make	1.0	liter

BLEACH

Water	800.0	ml
Potassium Ferricyanide	75.0	grams
Sodium Bromide	17.0	grams
Sodium Phosphate Dibasic	12.0	grams
Sodium Phosphate Monobasic	3.0	grams
Sodium Thiocyanate	6.2	grams
Water to make	1.0	liter

FIXER

Water	600.0	ml
Sodium Thiosulfate (anhy)	130.0	grams
Sodium Bisulfite	10.0	grams
Sodium Phosphate Monobasic	4.5	grams
Water to make	1.0	liter

STABILIZER

Formaldehyde	10.0	ml
Photo-Flo	1.0	ml
Water to make	1.0	liter

THE FOLLOWING CHANGE IS NECESSARY IN THE COLOR DEVELOPER WHEN PROCESSING EKTACHROME MS WHICH IS NORMALLY PROCESSED IN E-4:

Increase the amount of Citrazinic Acid to one gram.

* * *

SIMPLIFIED 18 MINUTE E-4 PROCESS

BY RAYMOND P. CZWAKIEL

This work was sponsored by the Rome Air Development Center, Griffiss Air Force Base, New York, under Contract F30602-72-C-0238.

SIMPLIFIED COLOR PROCESS FOR HIGH SPEED EKTACHROME

TIME/TEMPERATURE CHART

SOLUTION	TIME	TEMPERATURE (°F)
First Developer	3 min.	85 ± 2
Hardener	1 min.	85 ± 5
Wash	1 min.	"
Color Developer	5 min.	"
Stop Bath	3 min.	"
Bleach/Fix	3 min.	"
Wash	2 min.	"

This simplified process requires just 18 minutes of wet processing, uses only five different chemical solutions and two washes and has significantly expanded temperature tolerances. In addition, the Simplified Color Process can be utilized over a temperature range of 70°F to 100°F through adjustments to the time in the first developer. Total processing time varies from 15.5 min. at 100°F to 22 min. at 70°F.

Figure 3 compares the steps, temperatures and times for the E-4 and Simplified Color Process.

FIGURE 3

SIMPLIFIED COLOR PROCESS AND E-4 PROCESS COMPARED AT 85°F*

	KODAK E-4		SIMPLIFIED COLOR	
CHEMICAL SOLUTION	TIME (MIN)	TEMP °F	TIME (MIN)	TEMP °F
Prehardener	3 minutes	85 ± 1	-	—
Neutralizer	1 minute	85 ± 2		
First Developer	6 minutes	85 ± 1/2	3 minutes	85 ± 2
Stop Bath	2 minutes	85 ± 1/2	—	—
Hardener	—	—	1 minute	85 ± 5
Wash	4 minutes	85 ± 5	1 minute	85 ± 5
Color Developer	15 minutes	85 ± 2	5 minutes	85 ± 5
Stop Bath	3 minutes	85 ± 2	3 minutes	85 ± 5
Wash	3 minutes	85 ± 5	—	—
Bleach **	5 minutes	85 ± 2	3 minutes	85 ± 5
Fixer	6 minutes	85 ± 2	—	—
Wash	6 minutes	85 ± 5	2 minutes	85 ± 5
Stabilizer	1 minute	85 ± 2	—	—
Dry	—	110	—	105
TOTAL TIMES	55 MINUTES		18 MINUTES	

**Simplified color bleach is actually a combined bleach/fix.

SIMPLIFIED COLOR PROCESS (Continued)

From a pictorial imaging standpoint, the transparencies processed in Simplified Color Process Visually matched in color those processed in the Kodak E-4 chemicals.

PROCESS FORMULATION:

FIRST DEVELOPER

Kodak E-4 First Developer	475.0	ml
Graphidone (Philip Hunt)*	0.25	gram
Hydroquinone	3.75	grams
Ethylenediamine 93%	1.0	ml

HARDENER

Distilled Water	400.0	ml
Chromium Potassium Sulfate	15.0	grams
Sodium Sulfate (anhy)	25.0	grams
Water to make	475.0	ml

COLOR DEVELOPER

Kodak E-4 Color Developer	475.0	ml
Sodium Hydroxide 5N	19.0	ml
Kodak CD-3	2.5	grams
Ethylenediamine Sulfate	5.0	grams
Benzyl Alcohol	1.5	ml

STOP BATH

Distilled Water	350.0	ml
Sodium Thiosulfate (anhy)	75.0	grams
Sodium Bisulfite	10.0	grams
Water to make	475.0	ml

BLEACH/FIX (Stock Solution #1)

Distilled Water	375.0	ml
Potassium Dichromate	2.5	grams
Potassium Ferricyanide	50.0	grams
Potassium Bromide	10.0	grams
Carbowax 1540 (50% by weight)	3.0	ml
Water to make	475.0	ml

*Same as Phenidone (DD-5)

BLEACH/FIX (Stock Solution #2)

Distilled Water	600.0	ml
Sodium Thiosulfate (anhy)	500.0	grams
Water to make	950.0	ml

Just prior to use, mix as follows:

Stock Solution #1	190.0	ml
Stock Solution #2	50.0	ml

SUMMARY

This effort has shown that total processing times and required chemical inventories can be considerably reduced and that processing temperature latitudes can be significantly expanded both in total operating range and in individual solution tolerances for processing Color Reversal Film.

The Simplified Color Process is a "one-shot" chemistry designed to provide maximum uniformity in non-laboratory environs. The 240 ml (8 oz.) volume is used undiluted and fills a single roll Nikor type tank. If a different style is used, this volume would have to be altered using the same proportion of Bleach Stock Solutions, 1 and 2. Use of the Nikor reel tanks and 36 exposure rolls of film provides maximum economy because each solution is then used very nearly to completion. The 475 ml (1 pint) volume was chosen to obtain the best utilization of the Kodak chemistry for the first and color developers, which are still prepared in pints, quarts, half-gallon, etc. The volumes for the remainder of the processing solutions were kept the same to eliminate confusion. The metric designation is required for use in Department of Defense reports.

Chemistry can be prepared in larger volumes to reduce the mixing time required per roll. The shelf life of the two developer solutions in full, stoppered, glass bottles ranges from 2 to 4 weeks, depending on the ambient temperatures. The remaining solutions have life-times measured in months when stored in partially filled, glass bottles.

* * *

AGFACHROME PROCESSING FORMULAS

TIME/TEMPERATURE CHART

First Developer	12 - 13 min.	@ $75^{o}F \pm .5^{o}F$
Brief Rinse	20 sec.	@ 73 - $76^{o}F$
Stop-Hardener	3 min.	" "
Wash	4 min.	" "

Re-expose 10 sec. on each side of reel, one foot from 500 watt photo-flood.

Color Developer	11 min.	@ $75^{o}F \pm .5^{o}F$
Wash	14 - 20 min.	@ 73 - $77^{o}F$
Bleach	5 min.	" "
Wash	2 min.	" "
Fix	5 min.	" "
Final Wash	8 min.	" "

Rinse film in dilute photo-flo with 10 ml formalin per liter.

FIRST DEVELOPER

Calgon (Hexametaphosphate)	2.0	grams
Metol (or Elon)	3.0	grams
Sodium Sulfite (anhy)	40.0	grams
Hydroquinone	6.0	grams
Sodium Carbonate (mono)	58.5	grams
Potassium Thiocyanate	2.0	grams
Potassium Bromide	2.0	grams
Potassium Iodide	0.006	gram
Water to make	1.0	liter

STOP BATH

Glacial Acetic Acid	10.0	ml
Sodium Acetate, Crystals	40.0	grams
Water to make	1.0	liter

AGFACHROME PROCESSING FORMULAS (continued)

COLOR DEVELOPER: PART "A"

Sodium Sulfite (anhy)	3.5	grams
Hydroxylamine Hydrochloride	1.0	gram
Potassium Bromide	1.0	gram
N-Diethyl-p-Phenylene Diamine Sulfate DD-7	2.8	grams
2-Phenylethylamine*	3.0	ml
Water to make	300.0	ml

*NOTE: 8.0 ml of Ethylenediamine can replace the 3.0 ml of 2-Phenylethylamine.

COLOR DEVELOPER: PART "B"

Calgon (Hexametaphosphate)	2.0	grams
Sodium Carbonate (mono)	72.5	grams
Water to make	450.0	ml

Add "A" to "B", water to make 1. liter.

BLEACH

Potassium Ferricyanide	80.0	grams
Potassium Bromide	25.0	grams
Sodium Acetate, Crystals	50.0	grams
Boric Acid	5.0	grams
Potassium Alum	30.0	grams
Water to make	1.0	liter

FIX

Sodium Thiosulfate, Crystals	200.0	grams
Sodium Sulfite (anhy)	10.0	grams
Water to make	1.0	liter

* * *

ONE-SHOT FORMULAS FOR DRUM OR TUBE

PROCESSING KODAK EKTACHROME # 1993

Enclosed are working formulas for processing Ektachrome #1993 paper. Although, various Newsletter readers have successfully used the substitute formulas that we have published (see June 1969 Newsletter), a check using the Kodak kit first developer showed that the fog level after the first development was cleaner than that produced by using the substitute formulas.

This is easily verified if you use a print frame that puts a black border on the finished print. The first developer produces a black and white negative of the transparency and it is this white negative border that should be used to check the amount of fog produced by first development.

The secret is to be found in using Kodak's official first developer SD-35 formula (see May 1974 Newsletter). This formula stipulates using Kodak Anti-Fog #5. The unofficial formula recommended 6-nitrobenzimidazole Nitrate. If you should ask, "Why would that make a difference?", we would have to answer we do not know. We do know that there is a difference.

TWO WAYS TO PURCHASE KODAK'S ANTI-FOG #5

Kodak sells 1 pound for $58.80. If you would like to try this without buying a whole pound, we have repackaged it in 1. gram amounts as a service $6.50 postpaid. To order, simply write, "One gram Anti-Fog #5" and enclose your check for $6.50, Calif. add 6% sales tax.

If you are not into printing slides onto Ektachrome RC #1993 paper, you may not be aware that Kodak now sells a 25 sheet, 8"x10" package for $14.95, discounted in some stores to $10.00. We would recommend the purchasing of Kodak's booklet, E-96, **Printing Color Slides and Larger Transparencies.** This sells for $2.50. It contains many good tips on processing #1993, including the use of small drums.

In the December 1975 Newsletter, we published our thoughts on using #1993 in an article titled, "Getting Started with Ektachrome #1993 Paper". Most of the information in that article is still valid and we are quoting part of it:

Here is the system that we use to process #1993. Drum processing is fine for the first two steps, which is the critical part of the system and must be done in the dark. Once the paper is in the drum, the room lights can be switched on. After the stopbath, the print can be removed from the drum and the remainder of the process carried out in trays. The color developer and bleach/fix go to completion, so timing to make certain the reactions are complete is more important than shortening the process to a point that the solution does not have time to complete it's function.

We should tell you that we used a Unicolor drum and motorized base. We used the official R-500 solutions. We continued to use the kit chemistry until color balance was finalized. We also averaged out the 100°F temperature called for in this process as recommended by Kodak.

As we have pointed out, the R-500 uses a fogging color developer making re-exposure unnecessary. The R-500 instructions warn that streaking may result if the print is removed from the drum before completion of color development. On the other hand, the R-5 chemistry which does not contain a fogging agent in the color developer, instructions recommend normal room light after the stopbath. So, the first change we made was to see what would happen if we followed the R-5 procedure with the R-500 chemistry. After the stopbath, the print was removed from the drum and washed in a tray and then transferred to a tray containing the fogging color developer. The remaining steps were also done in trays. The use of one over-sized rubber glove was used to remove the print from the color developing tray. The number of prints that can be processed using the color developer in a tray should at least double that produced by using this solution as a one-shot. We used two different trays for washing, one after the stopbath and one after color development. The second wash tray was also used after the bleach/fix. This system prevented any possibility of bleach contamination before color development. If the first wash after the stopbath is done in the drum, one wash is sufficient.

There is another benefit of using a tray for the color developer. You can see color developing as it happens, when the white borders of the print are black, you know that color development is complete. You can watch the bleach/fix step and see the silver salts dissolve. This system also increases the number of prints that can be processed in the bleach/fix. There is another benefit, if the bleach/fix becomes exhausted, you can remove the print, dump the solution and fill the tray with fresh bleach/fix, then reinsert the unfinished print. Increasing the temperature of the color developer and the bleach/fix will speed up the process. A good check as to whether color development is complete is to check the black border after the print is dry and make certain that the border is truly black. A dark blue border is an indication of insufficient color development. It should be understood that the black border has nothing to do with color balance or exposure. It is strictly the result of no development in the first developer, sufficient re-exposure and complete color development. One word of warning, incomplete blixing could produce a false black. To check the efficiency of bleach/fixing regardless of whether you use a combination bleach/fix or a separate bleach and fix, the whites in the final print should be checked. The white **will** depend upon color balance, exposure, plus the balance of the system.

FORMULAS FOR PROCESS R-5

The following formulas use Kodak's official SD-37 first developer and color developer SD-38, with modifications to simplify the stop bath, bleach/fix and stabilizer. (See May 1974 Newsletter for complete Kodak P-111 official formulas). Also note that the time/temperature chart does not exactly follow the official recommendations.

The following formulas use Kodak's official SD-37 first developer and color developer SD-38, with modifications to simplify the stop bath, bleach/fix and stablilizer. (See May 1974 Newsletter for complete Kodak P-111 official formulas). Also note that the time/temperature chart does not exactly follow the official recommendations.

TIME/TEMPERATURE CHART

	75° F	85° F
1. First Developer (SD-37)	6 min.	4 min.
2. Stopbath	1 min.	1 min.
(REMAINING STEPS MAY BE DONE IN NORMAL ROOM LIGHT)		
3. First Wash	3 min.	2 min.
REVERSAL EXPOSURE: 15 Sec., emulsion side, 1 foot from No. 1 photoflood lamp.		
4. Color Developer (SD-38)	8 min.	4 min.
5. Stopbath	1 min.	1 min.
6. Wash	1 min.	1 min.
7. Bleach/fix	5 min.	3 min.
8. Final Wash	6 min.	3 min.
9. Stabilizer (1¼ oz. Formalin per gallon of water)	1 min.	1 min.
10. Rinse	½ min.	½ min.
11. Dry (not over 200°F)		

KODAK FIRST DEVELOPER SD-37

Water, about 90°F (32°C)	1.0 liter
Elon Developing Agent	0.9 gram
Sodium Sulfite (des.)	8.0 grams
Hydroquinone	2.35 grams
Potassium Bromide	0.55 grams
Kodalk Balanced Alkali*	25.5 grams
0.5% solution of Anit-Fog #5** (5-Methylbenzotriazole)	4.0 ml

Dissolve chemicals in the order given. Note the formula starts with 1 liter of water. Stir the mixture until each chemical is completely dissolved before adding the next chemical. The mixed developer should test as follows:

pH at 75°F (24°C) should be 10.03 ± 0.05.

Specific gravity at 75°F (24°C) should be 1.020 ± 0.003.

*Sodium Metaborate ($8H_2O$)

** To prepare a 0.5% solution, dissolve 1. gram of Anit-Fog #5 in 200. ml distilled water at 125°F.

NOTE: This developer has poor keeping properties, which can be improved by making an A & B solution. The A solution should contain everything except the Sodium Metaborate. Start with a total volume of 500. ml of water. Make up solution B to 500. ml of water and mix in only the Sodium Metaborate. Mix one part A to one part B before using.

STOPBATH (first and second)

Use 2% solution of Glacial Acetic acid, or the following formula:

KODAK STOPBATH SB-11

Water, about 90°F (32°C)	1.0 liter
Glacial Acetic Acid	18.9 ml
Sodium Acetate (des.)	3.0 grams

KODAK COLOR DEVELOPER SD-38

Water, 70° F to 80° F (21 to 27° C)	1.0 liter
Benzyl Alcohol	15.0 ml
Ethylenediamine-tetraacetic acid Na_4 (E.D.T.A. Na_4)	0.5 grams
Sodium Sulfite (des.)	2.0 grams
Hydroxylamine Sulfate	4.7 grams
Kodalk Balanced Alkali*	51.0 grams
Sodium Hydroxide (gran.)	2.5 grams
1% solution of Potassium Bromide**	10.0 ml
Kodak Color Developing Agent CD-3	4.0 grams
Ethylenediamine Sulfate	6.0 grams

*Sodium Metaborate ($8H_2O$)
**To make a 1% solution, dissolve 10 grams of Potassium Bromide in 1 liter of distilled water at 70° F (21° C).

NOTE: To improve the keeping properties of the color developer, leave out the CD-3 color developing agent until ready to use. Slowly, add 4. grams with stirring before use.

The main change between the old process P-111 and the newer R-5/R-500 is the elimination of the separate bleach (ferricyanide) and fixer (sodium or ammonium thiosulfate) in favor of the combined bleach/fix (using E.D.T.A. ferric salt and ammonium thiosulfate).

We have used the following bleach/fix successfully, which is the same one that we use for processing Ektacolor 37/74 RC paper.

BLEACH/FIX

Water	600.0 ml
Ammonium Thiosulfate (60%)	120.0 ml
Sodium Sulfite (anhy)	10.0 grams
Ferric Salt, E.D.T.A.	100.0 grams
E.D.T.A., Na4	5.0 grams
Ammonium or Sodium Thiocyanate	5.0 grams
Water to make	1.0 liter

NOTE: Use Sodium Carbonate or Sodium Bisulfite to adjust pH at 75° F to 6.8.

Another bleach/fix used by Richard Bisbey as a **one-shot** is as follows:

BLEACH/FIX

Stock Solution A

Water	350.0 ml
Potassium Ferricyanide	40.0 grams
Potassium Bromide	10.0 grams
Water to make	500.0 ml

Store in glass, keep in the dark.

Stock Solution B

Water	350.0 ml
Sodium Thiosulfate (penta)	200.0 grams
or	
Sodium Thiosulfate (anhy)	128.0 grams
Water to make	500.0 ml

IMPORTANT: This solution deteriorates VERY RAPIDLY when the A and B solutions are mixed together. The higher the solution temperature, the faster it will spoil. THIS A & B SOLUTION SHOULD BE MIXED 15 SECONDS BEFORE USE. Separately the A bath (ferricyanide solution) will keep for at least six months after mixing IF IT IS NOT EXTENSIVELY EXPOSED TO LIGHT. The B solution (sodium thiosulfate) will keep at least three months.

One change which will save the expense of using a blix made from ferricyanide and thiosulfate is to use the above ferricyanide solution as a separate bleach. If used in a drum, agitate for about one minute, then dump out the ferricyanide solution and save for future use. Then use the B bath of thiosulfate for one minute or so. The B bath should be discarded after use (as it is now contaminated with ferricyanide). Both of these solutions work very rapidly at room temperature. Timing is not critical.

We might add that we have personally tested and successfully used all of the above formulas for the last month. Richard Bisbey has also used the solutions for over three months with excellent results. I would also like to thank W. Ford Lehman of San Jose, Calif., for his helpful suggestions.

EKTACHROME NEGATIVES WITH ASA TO 1600

BY HARRY FOSBURY

Both Ektachromes, high speed and normal 64 will make a very good clear base color negative. A plus feature is that these films are available just about anywhere. After eight months of experimenting, I settled upon one developer and bleach formula. This formula is actually a bleach and fixer in one solution. Contrary to what I have read, the use of sodium thiocyanate in the bleach will not strip these emulsions. It does a beautiful job of bleaching and fixing, not to mention the extended solution life.

A working index for these two films is quite flexible. With the normal Ektachrome, I started at 64 and worked up to 400. I settled at 100 for this film. H.S. Ektachrome works best for me at 400. Pushing to 800 was easy, only 2 minutes longer in the developer. At 1600 very good negatives were obtained of a recent stage show with lots of colored lights. This was developed for 19 minutes. ASA 400 is the best and matches TRI-X as a companion, B & W film. H.S. Ektachrome is on the grainy side, but not objectionable. Ektachrome 64 is fine grain.

DEVELOPER: STOCK SOLUTION "A" (To be used as a one-shot)

Water 125°F	650.0	ml
Benzyl Alcohol	8.0	ml
Sodium Bisulfite	9.5	grams
Potassium Bromide	3.0	grams
Sodium Carbonate (mono)	120.0	grams

Pour in sodium carbonate slowly with constant stirring. The amount called for is just about the maximum that will go into solution.

Citrazinic Acid	4.0	grams
Add water to make	800.0	ml

LABEL "A"

<u>COLOR DEVELOPING AGENT STOCK SOLUTION "B"</u> (Prepare as a 20% solution of CD-3)

Water 125°F	80.0	ml
Sodium Bisulfite	2.0	grams
Kodak CD-3	20.0	grams
Water to make	100.0	ml

LABEL "B"

TO PREPARE WORKING SOLUTION: Use 100. ml of part "A". Add 100. ml of water. Then add 8. ml of part "B" stock solution. Bring the working solution up to a total of 250. ml, which is more than enough for a 35mm reel in Nikor tank.
pH should be 10.55 to 10.60.

BLEACH

Water 90°F	400.0	ml
Potassium Ferricyanade	25.0	grams
Sodium Thiocyanate	22.0	grams
Potassium Bromide	8.0	grams
Boric Acid	5.0	grams
Water to make	500.0	ml

These two formulas are the heart of the process. The only formula not listed is the F5 fixer. If you compounded your own fixer, the F5 formula is it. A one powder mix is available at most photo stores and will work as well. I haven't tried rapid fix, so I have no comment in this area.

PROCESSING SCHEDULE

	64 EKT.	H.S. EKT.
Developer 70°F	8 min.	12 min.
Water Rinse	30 sec.	"
F5 Fixer	5 min.	"
Wash	4 min.	"
Bleach	8 min.	"
Wash	8 min.	"
Wetting Agent & Dry.		

NOTE: USE AGITATION CONSTANTLY THROUGH ALL STEPS.

* * *

A DIVIDED FIRST DEVELOPER FOR CIBACHROME
by Richard Bisbey II

Those of you who have used Cibachrome have probably come to the conclusion that it is the most fantastic print material marketed today. You have probably also concluded that:

1. It is too contrasty,
2. It has severe crossover problems,
3. It is too expensive,
4. Practically ANY black and white developer or fixer can be substituted with results equivalent to the Cibachrome kit chemistry, and
5. No one seems to have formulated a good subsitute Dye Bleach to date.

Without a doubt, the single most obnoxious feature of Cibachrome is contrast. None of the tricks for lowering contrast such as overexposing and underdeveloping, diluting the developer, using softer developers, etc., seem to help very much. No matter how flat the original transparency, there will be some loss in highlight and/or shadow detail in the resulting Cibachrome print. Crossover, while not discussed as much, is also a significant problem. If you want to see it for yourself, try printing a gray scale on Cibachrome. The lowest density will print white, the highest will print black, the mid-point will be gray, and the remaining densities will be various shades of green and magenta.

For those of you willing to purchase five chemicals, help is on the way. For the past several months I have been using a divided first developer that has produced excellent results and that solves some of the problems.

1. It is soft. An entire gray scale can be printed without loss of either highlight or shadow detail. Your most contrasty Kodachromes and Ektachromes will yield prints that look exactly like the original transparency, not like color prints made from litho negatives.
2. Crossover is reduced. There is considerably less crossover with the divided developer than with the Cibachrome kit first developer.
3. It is cheap. The bath containing the developing agents and the bromide (the expensive chemicals) can be reused. The bath containing the inexpensive alkali is used one-shot. By purchasing the Cibachrome Bleach separately and mixing your own developer and fixer, chemistry costs are by about one half.

This fantastic formula is actually a black and white print developer published in an article by Paul Farber (November 1968, Dignan Newsletter), and brought to my attention Dr. M.L. Ellzey, Jr., University of Texas. In Farber's article, he said that he believed the formulas constituted " . . . a 'Universal' development system . . . ". Little did he know how right he was! The formulas are:

BATH A

Metol	6.5 gm
Sodium Sulfite	35.0 gm
Hydroquinone	2.8 gm
Potassium Bromide	2.8 gm
Sodium Chloride (salt)	0.6 gm
Water to	1.0 liter

BATH B

Sodium Carbonate (mono.)	105.0 gm
Water to	1.0 liter

PROCESSING TIME AT 75°F

Bath A	1 minute
Bath B	2 minutes
Cibachrome Kit Bleach	4 minutes
Fix	3 minutes
Wash	3 minutes

All times include a 15 second drain time. NO RINSE SHOULD OCCUR BETWEEN THE A AND B BATHS. After use, Bath A can be returned to its original container and reused. Bath B, the Bleach, and the Fix are used one shot.

GENERAL OBSERVATIONS

The lower contrast is probably due to a number of factors including the high metol to hydroquinone ratio, and the local exhaustion of developer in the B Bath.

While I have heard and read claims that the A Bath can be used "to the last drop" or that it "will last for years", I have my doubts. I started with 200 mls of the A Bath; several months (and about 25 8X10's) later I was down to less than 75 mls of very orange aerial oxidized A Bath. Obviously limits exist to reuse. They are undoubtedly based on storage, by-products of development, equipment used, and contamination by other chemicals. Perhaps only 100-200 8X10's can be processed per liter of A Bath, but even if the A Bath is used one shot, it's still cheap!

COLOR BALANCING WITHOUT A NEGATIVE

We have often stated that "producing color is very easy--producing the right color--this is the hard part." In May 1972, Marilyn Levy presented a paper at the Image 72 Conference of SPSE in San Francisco, explaining her patent USP 3,672,766. This patent explains how to color balance a print without the use of a negative. First, she explains the conventional systems available to the darkroom worker.

1. Scrambling the negative with a diffuser, adding correcting filters until a gray is produced. This system is inaccurate if one color predominates.
2. Flesh tones in standard negatives are printed until they match flesh tone of standard print. This makes all flesh color reproduce the same.
3. Gray card negative is printed until a standard gray is produced. This system is the best, but requires carrying a gray card when making exposures, which is inconvenient.

Miss Levy discovered that the UNEXPOSED AND DEVELOPED MASK common to all mask color negatives is almost equal to the exposure of an 18% gray card. In other words, instead of exposing a gray card, you use the unexposed, but developed film ends to arrive at a combination of filters that will produce a gray. If sheet film is used, it is necessary to develop one sheet that was not exposed, making certain that the emulsion number, storage, etc., are the same.

The results using this system are excellent if the color temperature of the exposing light is the same as that for which the film is designed. Exposures made at markedly different color temperatures will need slight printing filter corrections, different from the unexposed negative prediction.

To arrive at the correct gray filtration, this patent suggests the construction of a matrix made from the same filter material used to make the filter changes in the enlarger (see page 81).

When making filter changes, remember that combining different filters of the same value are not the same as one filter which equals the same total. An example given is a 40.cc (color compensating) magenta filter does not produce the same filtration as eight 5.cc magenta filters, or any other combination.

The reason for this discrepancy is caused by the imperfect filtering ability of the magenta filters, which not only stop green, but also a small amount of blue and red. Yellow filters are much closer to theoretical perfection. If for some reason you must resort to using cyan filtration, these filters are the least perfect of the three.

Gelatin filters usually must be cut to fit the filter drawer of most enlargers. When you order a set, make sure they are large enough to make the matrix from the material left over. This matrix can of course, be scaled up or down in size.

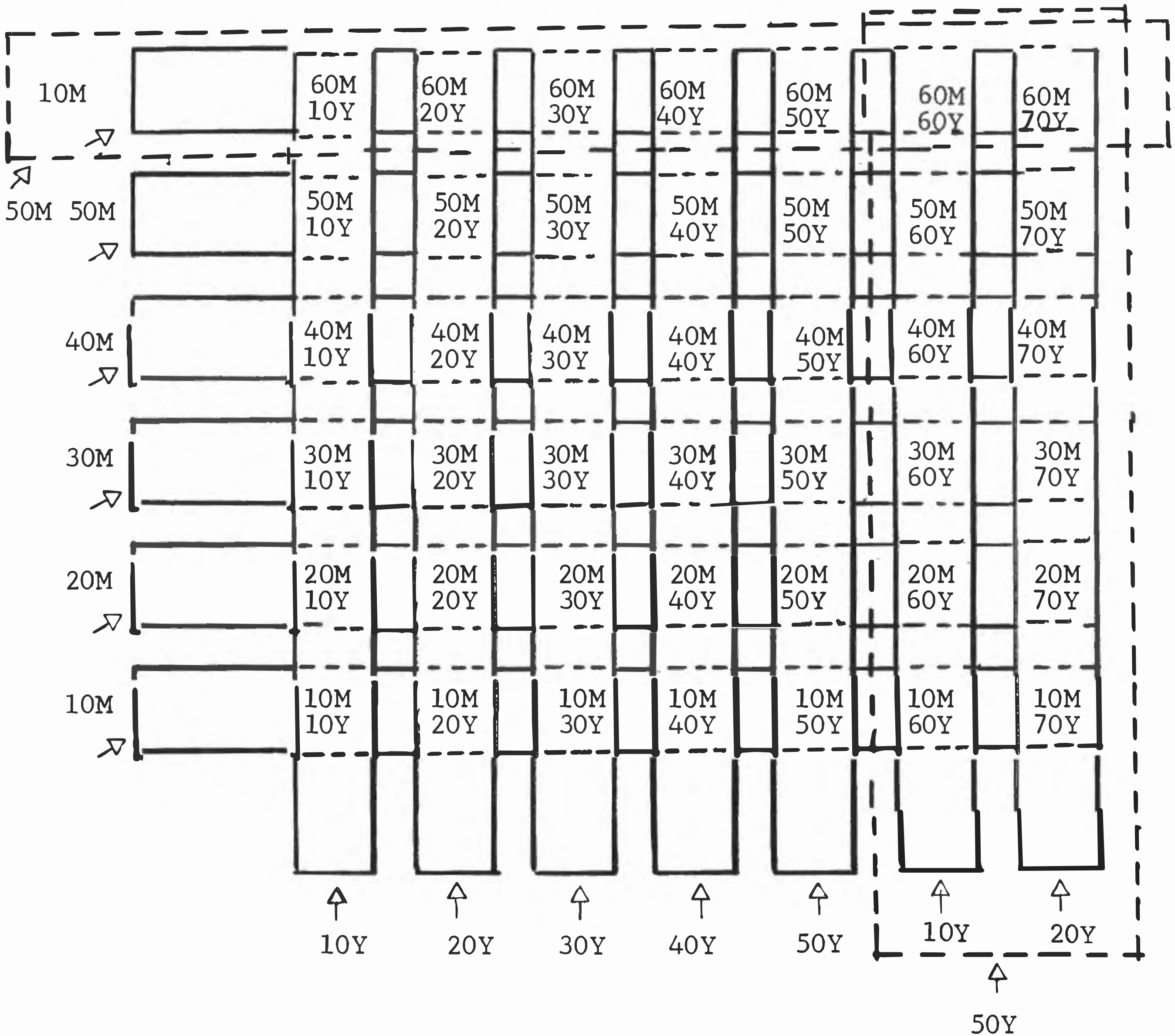
Using a matrix of filters next to a printing paper introduces reflections which can increase the effective density of the filter matrix. Unfortunately, these density increases are not linear and therefore are not predictable. This problem can also be helped by lifting the filters away from the paper using a thin, 1/8" sheet of Plexiglass, which also protects the matrix.

Another problem the reader may run into is balancing out exposure when using this type of matrix. This is easily solved by making a neutral density filter which is superimposed over the matrix. To make this neutral density filter, contact expose a sheet of Kodalith film under the matrix. One or two test exposures will give you a filter suitable for superimposing over your matrix. Mounting the matrix on 1/8" Plexiglass will solve the density increase caused by reflection.

After you have made your test print using the matrix, visually decide which square produces the best gray. Using an 18% gray card for comparison is very helpful. After making this decision, place the appropriate filters in the enlarger drawer. If everything has been done correctly, you should be able to print the complete roll without further filter changes, providing all of your camera exposures were made using the same lighting.

For those of you who may not want to bother with making your own calculator, Kodak, Unicolor and Beseler sell ready-made calculators. These are made from the same filters that make up the acetate filter sets, so that the problems caused by imperfect filters (the ones you place in your enlarger) are automatically corrected for by the recommendations of the calculator. However, any attempt to fine tune the final filter pack, may lead to problems. Just remember, it's not you, it's the filters.

* * *



SIMPLIFIED COLOR PROCESSING FORMULAS

OFFICIAL KODAK EKTAPRINT — 2 FORMULAS

For processing Kodak Ektacolor 37 & 74 RC paper.

Why did Kodak change from 3-step chemistry to the new Ektaprint-2? Obviously it is simpler to use two solutions, rather than three. Also one less solution eliminates a small amount of water polution in large processing laboratories.

However, the reason they can eliminate the stabilizer is due to the improvements in the dye couplers now used by Kodak. Another minor, but important reason is in the switch a few years back from Ferricyanide to Ferric E.D.T.A. as the bleaching agent. Whether it be Ammonium or Sodium salt, the Ferric E.D.T.A. washes out of an emulsion much more rapidly than Ferricyanide. Beseler chemistry uses a Ferric E.D.T.A. Sodium salt plus Sodium Thiosulfate bleach/fix to which they have added an optical brightener. The solution is also compounded to be slightly acid, probably with Bisulfite. Tests made in the past by Kodak on dye coupling type material, such as Kodak **print film** showed that dye fading was improved if the final solution was made slightly acid. It is probable that Beseler (Tetenal) used this fact in compounding their two step systems. But, as a number of photographic writers have pointed out, if the final wash water is alkaline (which it usually is) the use of an acid bleach/fix would be negated. There are two other reasons for maintaining a Ferric E.D.T.A./Thiosulfate bleach on the acid side, the solution functions faster, and keeps better.

Kodak would not have gone to a two step process if their present coupling dyes were not stable in either a slightly acid or slightly base condition. So, we feel the best plan when processing 37 & 74 RC is to extend the wash (3½ to 5 minutes in running water) and eliminate the stabilizer.

There is one other important consideration, if stain is encountered, a stopbath should be used between the developer and the bleach/fix. Kodak's Ektaprint-2 instructions list as optional a C-22 stopbath or the use of Ektaprint-3 stabilizer as a stopbath.

Although we are going to list the official Ektaprint-2 developer formula, we are not going to recommend it. It must be remembered that packaging requirements for concentrates are quite different when you only wish to compound a working solution.

We would recommend leaving out the following chemicals: With dionized water, leave out Anti-Calcium #5. The Solubilizing Agent is not needed. The Stain Reducing Agent Type 2 improves the whites and protects the dyes from ultra-violet fading. If the prints are to be viewed only by tungsten light, this chemical may also be deleted. The Potassium Chloride is only used in the Ektaprint-2 starter kit.

The CP-5 formula that was published in the Dignan Newsletter still performs with 37RC and the new faster emulsion 74RC.

We are repeating the formula that appeared in the Newsletter Jan. 1969.

DEVELOPER CP-5

Water (90°F)	700.0 ml
Benzyl Alcohol Stock Sol.*	26.0 ml
Calgon	2.0 grams
Sodium Sulfite (anhy)	2.1 grams
Hydroxylamine Sulfate	2.2 grams
Potassium Bromide	0.5 gram
Sodium Metaborate ($8H_2O$)	70.0 grams
Kodak Developing Agent CD-3	4.6 grams
Water to make	1.0 liter

pH (70°F) 10.3 ± 0.5

***Benzyl Alcohol Stock Solution**: This is made by using 50% Benzyl Alcohol and 50% Diethylene Glycol. This solution keeps indefinitely. Benzyl Alcohol will dissolve many plastics, keep in glass.

OFFICIAL EKTAPRINT-2 TIME/TEMPERATURE CHART

Developer (91°F ± 0.5°F)	3½ min.
Wash (86°F to 93°F)	1 min.
Bleach/Fix (86°F to 93°F)	1½ min.
Wash (86%F to 93°F)	3½ min.

Dry not over 225°F

For more complete information purchase Ektaprint-2 Developer which contains processing instructions.

OFFICIAL EKTAPRINT 2 FORMULA

	DEVELOPER		REPLENISHER	
Water	800.0	ml	800.0	ml
Ethylene Glycol	21.3	ml	21.3	ml
Benzyl Alcohol	15.1	ml	19.0	ml
Potassium Carbonate	32.0	grams	32.0	grams
Potassium Sulfite	2.1	grams	2.7	grams
Potassium Bromide	0.6	gram	0.0	grams
Hydroxylamine Sulfate	3.86	grams	4.86	grams
Anti Calcium #5*	.8	gram	1.42	grams
Stain Reducing Agent Type 2**	1.0	gram	2.13	grams
Solubilizing Agent***	1.78	grams	2.74	grams
Potassium Chloride	.25	gram	0.0	grams
CD3	4.85	grams	7.05	grams
Potassium Hydroxide (45% Sol)	1.1	ml	6.1	ml
Water to make	1.	liter	1.	liter

Developer:
pH 10.08
Specific Gravity 1.035
Total Alkalinity 22.1

Replenisher:
pH 10.32
Specific Gravity 1.040
Total Alkalinity 24.5

Developer Notes:

* Anti-Calcium #5: This is not readily available in small quantities. You may substitute Anti-Calcium #3 which is available from Lauder Chemical Co., catalog #A112-1; 2 ounces $1.95.

** Stain Reducing Agent Type 2: This is Tinopal SFP ultra-violet brightening agent. This is available from Lauder Chemical Co. 4 ounces $5.95. The chemical name for this fluorescent brightening agent is:
7-{[4-CHLORO-6-(DIETHYLAMINO)-S-TRIAZIN-2-YL] AMINO}-3-PHENYLCOUMARIN

*** Solubilizing Agent: This is Lithium Sulfate.

If you wish you may substitute Diethylene Glycol for Ethylene Glycol using approximately 5. ml per liter.

BLEACH FIX (nonregenerated system)

Water (70° to 80.6°F)	600.0	ml
Kodak Bleaching Agent Bl-1	115.0	ml
Ammonium Hypo (60%)	172.5	ml
Sodium Bisulfite (anhy)	13.0	grams
Water to make	1.	liter

pH at 80.6°F 6.45
Specific Gravity at 80.6°F 1.111

THE FUTURE IN COLOR PROCESSING

Due to the present world inflation, it would seem to us that the practicalities of marketing and manufacture, will limit the number of different chemicals that will be made available to all industries.

If this assumption is correct, we can look into the future where only a few black & white developing agents are produced, perhaps only the three that we have listed; Phenidone, Elon/Metol and Hydroquinone. The same situation can be applied to color developing agents. Perhaps only two will be needed to process all color emulsions (with the exception of a Kodachrome type material).

It has been estimated that today there are only 25 different "color couplers" used in all color photography. Again, these will probably be reduced to nine or at the most, twelve. In other words, we can look for still more simplification in color processing as the years go by.

Also, within the next ten years we will see a number of changes aimed at simplification. Two solution processing units for color print paper and negative color, utilizing a monobath and wash step. The drying unit will also be included. The complications of processing a reversal emulsion, whether it be a transparency or print will also utilize a monobath. Emulsion changes will eliminate the reversal developer.

Our darkroom of the future will be quite different; micro-electronics and lasers will control color balance, timing, exposure and focusing. Cropping for best composition will remain the one important item requiring human judgement. Even today, Polaroid has introduced an 8"x10" color print material that is exposed in the camera and then squeegeed through a monobath.

In the last twenty years we have gone from color processing that required over an hour, down to less than 10 minutes today. Perhaps we will miss today.....the good old days!

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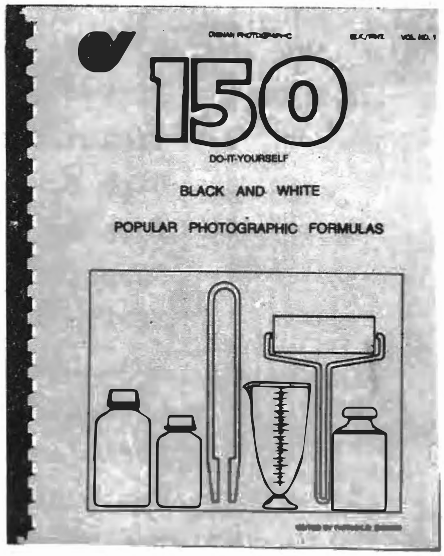

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